739*a

A NEW TREATISE OF ASTRONOMY, OR Aſtronomy opened:

531.k.20.3

BEING

A Rational and Mathematic Enquiry into the True Principles
and Nature of

ASTRONOMY,

Or Frame of our

SOLAR SYSTEM.

MVSEVM BRITANNICVM

WHEREIN

Divers and weighty Reaſons will be offered, to ſhew that the preſent-received SYSTEM cannot *poſſibly* be the TRUE ONE.

Alſo a NEW SYSTEM will be humbly propoſed, for the Examination of the LEARNED, whereby all the Cœleſtial Phænomena will be much more naturally explained, and accounted for, than by the preſent Syſtem, and without that oblique and unnatural Motion of the EARTH our Aſtronomers are obliged to ſuppoſe.

By *SAMUEL BAMFIELD*,

Teacher of MATHEMATICS, at HONITON, DEVON.

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MVSEVM
BRITAN
NICVM

Revd Sr Honiton Feby 20th — 64

As my Book is now published I desire you wd be pleas'd to accept of a Copy: and I presume that ye impartial & capable Reader will receive some Pleasure from ye Performance of

Revd Sir

yr most obliged

humm Servt

Sm Bamfield

Please to let Dr. Bliss & Mr Maskelyne have a sight of it.

TO

The Honourable
Sir GEORGE YONGE,

OF

ESCOTT, in the County of DEVON, Baronet.

HONOURED SIR,

AS I now, by your familiar and agreeable Converſation, find that you not only greatly delight in that ſublime Science of Aſtronomy, but do alſo underſtand many of the moſt curious Parts thereof, I humbly beg Leave to inſcribe the following Treatiſe of New Aſtronomy to You, Sir, for theſe following Reaſons, viz.

Firſt, Becauſe you are the only neighbouring Gentleman of ſo great a Rank as you are placed in, that I have had the Honour of being acquainted with, who do ſo much delight~~s~~ in that pleaſing and grand Study of the Heavens as you do, Sir; a Science which has employ'd the Pens of the greateſt and wiſeſt Men of all Ages, and has not only been highly encouraged, but likewiſe laboriouſly ſtudied, by many wiſe and excellent Princes. And I humbly hope you will not deſpiſe or reject this Offering, becauſe it is not the Product of a Perſon of great Rank or Fortune; but that you would be pleaſed to look on it according to its Merit or Demerit: And that there are here many Things new and curious, I am quite poſitive. And, I preſume, it ſhould not be look'd on lightly and with Diſdain, purely becauſe it is oppoſite to the preſent received Opinions of Aſtronomers: For we know that the ancient Pythagorean Syſtem, which long exiſted, was either exploded or neglected, and other Syſtems ſubſtituted in its Room, as the Ptolemaic, Tychonic, and Semi-Tychonic: But the ancient Hypotheſis was revived by COPERNICUS, tho' ſince altered by KEPLER, in the deſcriptive Figure of the Orbits of the Planets, viz. from Circular to Elliptic.

I mention theſe Things not to inform you, Sir, but only to ſhew, that, altho' a particular Syſtem has been ever ſo long and ſtrenuouſly embraced, Futurity may find Objections and overthrow it, as witneſs the above-mentioned; but I do not pretend to ſay that this Treatiſe will overturn that which is commonly called the Newtonian, tho' in Fact the Keplerian, but ſhall leave my Arguments to ſpeak for themſelves; and if they are erected on an unſound Baſis, they will, doubtleſs, quickly fall. I acknowledge that an abler Pen might greatly embelliſh my Arguments, and perhaps heighten the Language equal to the Subject, tho' the latter is capable of admitting the greateſt Sublimity and loftieſt Expreſſions: But I am content to publiſh Truth (or at leaſt what I think ſo) in a homely Dreſs,

hoping

hoping it will not be diſregarded purely on that Footing.

Another great Reaſon for this Dedication is, the Remembrance of your Truly Great and Benevolent Father, who long and ſplendidly filled ſome of the Higheſt Places of Honour in the Kingdoms of *England* and *Ireland*, and diſcharged the great Truſt repoſed in him, with uncommon Integrity and univerſal Applauſe. He was ſuch a great Lover of, and conſtant Advocate for, True Liberty, as is far beyond my Power to deſcribe: But this I may ſay, that in many Debates of great Importance, both in Eccleſiaſtical and Civil Matters, he behaved ſo bravely, and diſputed ſo learnedly, that, rather than he would betray his Judgment, or unreaſonably ſacrifice his Opinion, he choſe to diſoblige even his beſt and greateſt Friends, without any mercenary View whatſoever.

This Gentleman's frequent and learned Debates in the Houſe of Commons, on all Occaſions, moſt manifeſtly exhibited his univerſal Knowledge, which he diſplay'd in the moſt eaſy Manner, with ſweet Harmony, great Freedom, and admirable Eloquence.

Moſt remarkable was Sir WILLIAM in forgiving his Enemies, and not only ſo, but exerted his utmoſt Skill to ſerve and oblige them, by which attractive Behaviour he brought ſome of his greateſt Enemies to be ſome of his beſt Advocates and ſincereſt Friends.

Your learned Grandfather (tho' to me ſcarce known) ought not here to be omitted, who ſhew'd his ſuſceptible Son the glorious Patterns above deſcribed; for this Gentleman, even in the firſt Seſſion of Parliament that he had the Honour to attend, made many eloquent Speeches, to the Satisfaction and Surprize of the learned Auditors.

Go on, therefore, worthy Sir, and endeavour to imitate your eloquent Predeceſſors, in practiſing all thoſe Things which are thus Honourable, Virtuous, and Praiſe-worthy. May you hereafter ſhine in this

Kingdom's auguſt Aſſembly as they did! May you make it your daily Study to follow thoſe laudable Examples, and add, if poſſible, ſome others, ſo that you may be admired and reſpected, not only by all thoſe numerous and worthy Gentlemen you have the Honour to be already acquainted with, but by all Mankind! which that you may do, is the ſincere Wiſh and Deſire of,

HONOURED SIR,

Your moſt obliged

and moſt obedient

humble Servant,

Samuel Bamfield.

THE

PREFACE.

To the impartial and unprejudiced Reader.

TO ſend a Book on ſuch an important Subject abroad in the World without a Preface, aſſigning ſome Reaſons for its Publication, I preſume, will appear inconſiſtent, eſpecially when it oppoſes numerous Volumes of the moſt ſagacious and penetrating Aſtronomers. But if either their Demonſtrations are not truly Mathematic, or their Conceptions are unnatural, and attended with Doubts and inſolvable Intricacies, I imagine, a Reader may juſtly diſſent, provided he cannot be convinced, when he ſincerely and honeſtly enquires for the Truth; as I here declare is my Caſe: And as I have diligently ſearch'd, and cannot be ſatisfied, I diſagree in many Things with our moſt celebrated Aſtronomers.

It is well known that the PTOLEMAIC and TYCHONIC Syſtems both ſtood long, and had their Admirers, tho' at laſt they were moſt juſtly overthrown.

If any Perſon ſhould, thro' Prejudice, Prepoſſeſſion, &c. take up his Pen againſt me, I beg he would uſe me with fair Argument, Candour, and decent Language. But if that ſhould not be the Caſe, Truth is not likely to appear, and inſtead of Diſcovery or Improvement, probably will be ſubſtituted Confuſion and Banter, and perhaps to the Diſcredit of both the Oppoſer and Oppoſed. If I am candidly treated, I will readily anſwer (as far as in my Power) any Gentleman's Objections, if he pleaſes to ſend them to me in a Poſt-paid Letter, and alſo acknowledge my Errors, if ſo proved: But I beg that no Perſon would condemn before he has thoroughly examined this whole Tract, and not read it like Hiſtory.

One Thing, I own, bears hard againſt me, which is, that every Aſtronomer in Europe differs from me in Opinion at preſent. 'Tis not like Party. And Experience convinces us, that it is extremely difficult to turn People out of the beaten Track: And ſome are ſo bigoted, that they will ſcarce read, much leſs examine, what is oppoſite to their Tenets But certainly this Practice or Omiſſion cannot be laudable in any reſpect whatſoever; and I hope there are ſome Gentlemen, who have a ſufficient Capacity, will not only read, but ſtrictly examine, this Treatiſe, and uſe me as I deſerve. We know the Philoſophy of DES CARTES was in high Repute for a conſiderable Time, before a NEWTON appeared; but ſince moſt juſtly exploded. How long the preſent Syſtem of Aſtronomy may ſtand is a Queſtion.

I am not inſenſible but that my Taſk is a very arduous one indeed; and I make no Doubt but ſome Bigots will ſneer at my ſtrange and uncommon Notions at firſt: But if it ſhould ſo happen, after ſtrict Reaſoning, that I ſhould have Truth, or even great Probability, on my Side, I will not ſneer at them, nor triumph in Victory, if obtained.

Whenever I imagine that Nature ſeems to be forced, diſtorted, or too laborious in her imaginary Operations, and that ſhe does not act the ſhorteſt and eaſieſt Way, I then begin to conſider, whether more Simplicity and Eaſe cannot be found for the ſame Phœnomenon; and when I think that I have diſcovered what I ſought for, I have then endeavoured to raiſe Objections to my own Ideas or Conceptions, and, after weighing them impartially (if an Author is allowed that Qualification), and I cannot ſet them aſide, I have concluded my Notions to be right. And if they are ſo, I apprehend, the Calculation of Eclipſes, &c. will be much abbreviated;

which is a Thing greatly to be wiſhed: For every Perſon who has gone through every Part of the Calculation of a Solar Eclipſe muſt acknowledge 'tis a Work of much Labour.

If any KEPLERIAN or NEWTONIAN ſhould attack my Writings, I muſt acquaint him, that I ſhall take it as no Proof in quoting this or that Author, without ſtrict Mathematical Demonſtration appears. His aſſerting that the Quantity of Refraction of the Sun, Moon, and Stars, are preciſely, in all Reſpects, the ſame, and the Quantity already indiſputably determined, is not any Proof. I have great Reaſons to think far otherwiſe; as did TYCHO, the Diſcoverer thereof; and hereafter in this Treatiſe I ſhall largely explain the Nature of Refraction in the Heavenly Bodies, and ſhew how to obtain the Quantity thereof: For I cannot find that any truly-mathematical Method has ever yet been practiſed for determining it. And 'tis a Matter of Surprize to me how Aſtronomers can think that when the Moon's apparent Meridian Altitude here in England is equal to the Complement of Latitude, and alſo the Sun's in like Manner, that theſe Bodies ſhall both be really in the Plane of the Equinoctial, or in the Zenith to an Equatorean; when we know the Diſtance of the Moon from us is exceeding ſmall in Compariſon to that of the Sun. A ſingle Thought by the Judicious muſt needs ſhew the Impoſſibility of it, and I think convince them that the Refraction of the Sun and Moon is very different.

Alſo his ſaying that the Sun's Parallax is but Ten Seconds, and conſequently that the Sun is 81 Millions of Miles diſtant from us, is not any Argument. The incomparable Sir ISAAC NEWTON indeed makes his Parallax but 10″; and Mr. MACHIN makes it but 8″, by which the Sun's Diſtance will be about 100 Millions of Miles: And that excellent Aſtronomer Mr. CASSINI made the Diſtance 172,800,000 Miles, as HARRIS's Lexicon Technicum informs us, under the Word SUN, Vol. 2. But Mr. WHISTON, who was a very learned Author, takes the Sun's Parallax to be 32″, and from thence the Sun's Diſtance will be about 26 Millions of Miles. Thus we ſee the greateſt Aſtronomers diſagree vaſtly; which I do not wonder at, becauſe the Methods by which they ſeek this Luminary's Diſtance are in no wiſe to be depended on. But our Aſtronomers think that a few Millions of Miles do make ſcarce any Difference in Obſervations, tho' I believe they will hereafter find it far otherwiſe.

That great Obſerver and Diſcoverer Mr. CASSINI ſays, that the Diameter of Venus is equal to Seven Semi-Diameters of our Earth, tho' all our modern Aſtronomers make their Diameters nearly alike, and the Times of Revolutions about their Axes alſo; but I cannot find, by the Methods our Aſtronomers have taken, that we can rely on the Times of Revolution of the Planets about their Axes they have given us, nor on their Magnitude. CASSINI, in 1666, ſays, That he obſerved ſeveral Spots in the Body of Venus, by whoſe Motion he judged (tho' he acknowledged he was not certain) that ſhe moved round her Axis in about 23 Hours, which Time our preſent Aſtronomers nearly adhere to. But the famous KEPLER, HERIGONE, RHÆTENSIS, KIRCHER, and SCHOTTUS, conjectured that ſhe revolves about her Axis in 14 Hours. Now, what can we conclude from theſe Aſtronomers? Why I think only this, that ſhe does actually revolve about her Axis, but in what Time we are not certain; and the Diſagreement in our Aſtronomers Account is ſo great, that it cannot be reconciled by even the moſt Learned: And I here freely confeſs, that I do not know, at preſent, any ſure or ſtrictly mathematical Method, free from all Objection, accurately to determine the preciſe Times of the Revolutions either of Mars or Venus about their Axes. There are many more Difficulties, I imagine, to be encountered with in the Work than Aſtronomers are aware of. The different Situations of Planets in their Orbits will make great Differences in Appearance to us, as to the Time of a preciſe or actual Revolution: For ſometimes they may appear to us to revolve about their Axes much ſwifter than at other Times, as is eaſy to be demonſtrated, if there is a Neceſſity.

We generally find that the greateſt Part of Mankind implicitly rely on the Greateſt Names; and many, without a ſufficient Capacity to judge, tho' they more loudly and abſolutely determine than thoſe who are competent Judges. For my Part, I openly declare, that the moſt lofty Titles ſhall not draw my Conſent, unleſs I find Truth in the Volume: Nor, on the contrary, ſhall I deſpiſe or reject this Gem if advanced from a Cottage. I am ſurprized that a truly-geometric Aſtronomer ſhould acquieſce with the common Methods of finding the Sun's Diſtance, knowing that a ſingle Second may make ſome Millions of Miles Difference: And Mr. KEILL, perhaps one of the beſt Aſtronomers that ever wrote, ſays, no Man can be ſure he has not committed an Error of a whole Minute.

I heartily wiſh People would pay ſome Regard to Mr. POPE's Aſſertion, viz. That there are not many certain Truths in the World, and that it is much better to ſtudy the large, open, and perceptible Parts which we know, than the finer ones which will for ever eſcape our Knowledge; tho' to our Diſhonour be it ſpoken, we find moſt of our Diſputes are upon theſe laſt.

I cannot refrain joining with the Authors of the late Mathematical Tranſactions in this, viz. That a little Knowledge in Mathematics properly applied will lead on to more uſeful Diſcoveries than all the abſtracted Speculations in the World.

Of what Uſe to Mankind are many of the infinite Series, and great Part of the Exponential Equations, whoſe Indices have Indices? Of what great Uſe are the infinite Variety of Curves to the Improvement of uſeful Science; as the Conchoid, Ciſſoid, Trochoid, &c.? The different Kinds of Hyperbola's and Parabola's; and, of the latter, the Cubical, whoſe Ordinates increaſe in a ſubtriplicate Ratio of the Abſciſſa's; the ſubquadruplicate, the ſubquintuplicate, &c.? But I acknowledge that the underſtanding of the Properties of theſe Curves is very curious, and pleaſing to the Artiſt; and I would not attempt to diſcourage the Study of theſe intricate and abſtruſe Matters. But I would have Students chiefly employ themſelves about ſuch Things as are uſeful, and may come into Practice. Some Curves, I own, are very remarkable, and have uſeful and extraordinary Properties; as the Apollonian Parabola, which Curve is deſcribed by a Projectile in a Nonreſiſting Medium: Alſo the Cycloid, wherein if a Pendulum vibrates, whether the Arches be great or ſmall, the Times of Vibrations will be iſochronous, i. e. exactly equal among themſelves. The Logarithmic Line of Pardie, which diſcovers all the Myſteries of Logarithms; and the Catenarian Curve, which is the ſtrongeſt of all Arches whatſoever to ſupport a Weight, &c.

The Diſcovery of the Aberration of Light from the fixed Stars ariſing from the Earth's Motion is doubtleſs very curious, and ſtrictly true, agreeable to Dr. Bevis, tho' diſcovered accidentally by Dr. Bradley; and I wiſh I could ſay uſeful alſo: But there is one Thing makes me laugh, viz. That the *Light* which comes from the bright Star in the Head of Draco to us, is ſaid to be above Six Years in coming. Amazing! I ſhall give ſome other Cauſe for theſe Phœnomena hereafter; for the Cauſes ſuppoſed are not adequate to the Effects. But ſuppoſing it, the Difference occaſioned thereby is ſo inconſiderable, that it may be, and we ſee is, ſafely neglected in all Aſtronomical Calculations, and is, I preſume, never more than what may ariſe from the Inaccuracy of Obſervation; for no Obſerver can be ſure that he has not committed an Error ſo great as that of which I am now ſpeaking. Certainly we ſhould not endeavour fully to explain ſuch Niceties and Difficulties as are beyond us. What Advantage or Satisfaction accrued from the ſharp philoſophical Diſpute between Clark and Leibnitz? None truly; tho' they were two as great Reaſoners and Philoſophers almoſt as the World had produced; and the Whole at laſt ended in this bitter Sarcaſm, viz.

> " Leibnitz and Clark
> " Both fought in the Dark."

How ſhall we reconcile Dr. Halley and Mr. Flamstead, two of ſo great Aſtronomers almoſt as ever lived, concerning the following Nicety, viz. Whether there is a Parallax of the fixed Stars, or not? the former pronouncing there can be no ſuch Parallax diſcovered; but the latter affirms the contrary, and ſays that the Quantity thereof is about 42″. There certainly is ſome Difference, tho' we cannot exactly aſcertain it. But was the Earth's Orbit of that vaſt Stretch our Aſtronomers imagine, i. e. about One Hundred Sixty-three Millions of Miles, there would be, beyond all Doubt, a very ſenſible Parallax indeed, notwithſtanding the ſuppoſed immenſe Diſtance of the fixed Stars. But I do not ſcruple to ſay, that, ſo far as I have examined into our Aſtronomers Methods for diſcovering the Earth's Annual Parallax, they never took any Method which might with Certainty be rely'd on. They run direct juſt as the Problem ſeems to appear at firſt Sight: But it is well known that in ſome Algebraic Proceſſes we are obliged to frame divers Kinds of Subſtitutions, and perhaps ſometimes there is but one certain Form that will give any Clearneſs or Elegancy to the Solution. How often in Spherical Triangles do we make uſe of the Parts of one Triangle to find the Parts of another? And, in the higher Parts of Mathematics, we are often obliged to add divers Kinds of Figures, &c. before ever we can prepare for a Solution. And there is likewiſe a Nutation of the Poles, I preſume, tho' Aſtronomers have not yet determined what the greateſt Difference is. We do not know certainly what Power one Body has upon another in this planetary Syſtem to attract or draw aſide, for even in a common magnetic Attraction we are not poſitive; no univerſal Law can be aſcertained. Sir ISAAC ſuppoſes it to decreaſe in the triplicate Ratio of the Diſtance; but Dr. HELSHAM ſays, it is as the Squares of the Diſtances inverſely; and Mr. MARTIN aſſures us, that it is in the ſeſquiplicate Ratio of the Diſtances inverſely: From whence we may juſtly conclude (notwithſtanding ſo much is ſaid), that there is no regular Proportion in the Increaſe of this Attraction, &c. agreeable to the ingenious MUSCHENBRAEK. I ſhould be glad to know what Diſcovery (for I will not ſay Diſcoveries) has been made from all thoſe mighty, expenſive, and extenſive Obſervations of the late Tranſit of Venus over the Sun. I affirm there is not one of Note. Some Perſons indeed are inclined to think ſhe has an Atmoſphere; but that is to little or no Purpoſe, nor was it the Buſineſs of Aſtronomers. See the late Philoſophical Tranſactions, P. 199, &c.

The Rev. Dr. Bliss, F. R. S. obſerves, that the intended Diſcovery may probably be reſerved for the Reign of his preſent Majeſty, &c. &c. which plainly indicates all theſe Obſervations proved ineffectual, and quite unſatisfactory.

The Rev. Mr. Maskelyne, F. R. S. very judiciouſly doubts whether the Difference in the total Duration of the Tranſit of Venus over the Sun's Diſk, obſerved in any two Places, where it is likely Obſervations have been made, will be great enough to enable us to infer the Sun's Parallax with ſufficient Exactneſs; or even nearer than it is known already. This Gentleman ſays alſo (which deſerves Remark) that he was ſurprized to ſee Venus appear ſo large, and ſo near the Sun's Limb, and that ſhe made a more ſpeedy Exit from the Sun's Body than Calculations allowed; from whence I think we may juſtly conclude that our preſent received Syſtem is not the true one.

I muſt deſire any Oppoſer to reaſon from the Nature, &c. of my Objections hereafter raiſed, and not by other

Schemes, &c. foreign to the Purpoſe, that the Strength or Weakneſs of my Reaſonings may be fairly tried and determined: And if they are of little or no Force, it cannot require either much Skill or Time for an Artiſt to overthrow them. The bare affirming that my Objections are of no Force is as weak and unmanly as impertinent in any Perſon, and will deſerve no Notice unleſs the Reaſons are written, that they may be ſtrictly examined. The ſaying 'tis not worth a Gentleman's while to anſwer my Objections can avail but little, and ſuch an Aſſertion muſt be looked upon (if any Gentleman ſhould be ſo weak as to urge it) as if the Aſſertor underſtands not what he reads, or is incapable of giving any Anſwer to it. And if any ill-natur'd Reader (as many, I preſume, there will be) ſhould ſay that I would not have ventured to have contradicted theſe Great Men had they been living; I would aſk the ſame Perſon, whether there are not many great Aſtronomers now living who ſtrenuouſly embrace and maintain the very ſame Principles they did? And if ſo, it lies upon them to vindicate theſe ſame Principles, and overthrow my Objections, becauſe they are quite oppoſite to the received Syſtem, and offer to ſtrike it to pieces.

If I ſhould not convince my Readers of what I endeavour to do, I cannot perceive any Injury can ariſe herefrom to any Perſon whatſoever; and if I ſhould not expreſs myſelf in Language quite adequate to the ſublime Subject (as I am ſenſible I cannot), I hope the generous Reader will pardon me, becauſe I endeavour to diſplay Truth and Reaſon, more than a nice Form of Words, or Sublimity of Style.

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A NEW TREATISE OF ASTRONOMY, OR ASTRONOMY OPENED, &c.

CHAPTER I.

Of the preſent Aſtronomy.

IT is now univerſally believed and aſſerted (I preſume) by all modern Aſtronomers, that every Primary Planet moves in an Elliptical Orbit about the Sun, which takes his fixed Reſidence in one of the Foci thereof, only with a Revolution about his Axis; conſequently a Planet muſt be much nearer in Perihelion to the Sun than in Aphelion; and it is allowed that the Eccentricity of the Earth's Orbit is 17 of ſuch Parts, as the Sun's mean Diſtance from us is 1000; whence it is eaſily found that the Sun is nearer the Earth one Time than another (according to the preſent Syſtem) almoſt Three Millions of Miles, and the neareſt Approach is affirmed to be nearly in the Depth of our Winter.

It is likewiſe aſſerted, that the Earth moves much faſter in our Winter than in Summer, and ſome make it about a Fifteenth Part faſter when in Perihelion than in Aphelion :

Alſo 'tis ſaid, that the Sun tarries Eight Days longer on the North Side of the Equinoctial than on the South Side :

Alſo, that the Earth revolves about its Axis from Weſt to Eaſt, but is carried along the Ecliptic Line :

Alſo, that a General Law obtains throughout the whole Planetary Syſtem, ſo that the Squares of their periodic Time of every Planet, whether Primary or Secondary, are in Proportion to one another as the Cubes of the Diſtances from the Centre of their Orbits :

And it is univerſally agreed on alſo, that there are four Times in the Year when good Clocks and Sun-Dials will keep exact Time together, and at all other Times differ :

Alſo, that the Poles of our Earth deſcribe Circles about the Poles of the Ecliptic, and that the Axis of the Earth will deſcribe the Surface of two Cones, having one common Vertex at the Centre of the Earth :

And, laſtly, 'tis aſſerted, that every Comet revolves in a very eccentric Orbit about our Sun, and that Comets, like all other Planets, ſweep or deſcribe equal Areas in equal Times about the Sun :--- All which Affirmations I ſhall endeavour to confute, or ſhew their Inconſiſtency with our preſent received Syſtem, and proceed in the following Order.

CHAPTER II.

Concerning the Equation of Time.

THAT there are four Times in the Year when a well-regulated Time-Piece will and ought to keep equal Space or Time with the Sun is undeniable; but that ſuch an Orbit as all Aſtronomers have given our Earth ever ſince KEPLER will be the Cauſe of it, is, I think, quite impoſſible; for certainly it can be no more than twice by the Nature of an Elliptical Orbit.

ILLUSTRATION.

LET ⊙ repreſent the fixed Seat of the Sun (Plate I. Fig. 1.), and A, C, P a Semi-Orbit of the Earth, A the Place of Aphelion, and P the Perihelion. Now let us ſuppoſe our Earth at P, and moving thro' E D C B A, and to paſs from P to E in a certain fixed Time, as perhaps one Day; ſhe will then move fartheſt of all, by the Laws of Gravitation or Attraction, &c. as is allow'd; and conſequently the Arch P E muſt exceed or be greater than an Arch of mean or equal Time; and in paſſing over the Arch B A ſhe will move ſloweſt of all, and therefore the Arch will be leſs than, or fall ſhort of, mean or equal Time. Now, ſince it is thus, there can be but one Place in this Semi-Orbit wherein the Earth will deſcribe any definite Arch juſt equal to mean or equal Time, as ſuppoſe C D, than which nothing (I conceive) can be more obvious to any curious Enquirer. And it lies upon the Eſpouſers of the preſent Syſtem to ſhew the Poſſibility of the Sun and Clock's keeping Time together four Times in the Year, from the Earth's Motion in an elliptic Orbit, and a Clock's keeping equal Time: For it cannot be imagined that the Earth moves by Starts faſter and ſlower, &c. in her Journey from P to A, but decreaſes in Velocity uniformly. And if it ſhould be ſaid

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by the Unphiloſophical, or for the ſake of Contradiction, that we are not ſure that the Earth moves faſteſt in Perihelion and ſloweſt in Aphelion, but that it might be exactly the contrary, for what we know, this can avail nothing, for the Effects will be very nearly the ſame, as it muſt appear to any reaſonable or mathematic Enquirer.

Further, it is highly remarkable, that our beſt Engliſh Aſtronomers ſay that two of theſe Times are in *June* and *December*, whilſt the Earth is nearly in both Extremes of Motion, which to me ſeems very abſurd and quite irreconcileable. CAILLE ſays, that the Times when the True and Mean Day agree are the 1ſt of *February*, the 3d of *May*, the 15th of *July*, and the 20th of *October*, O. S. which Times, I imagine, are nearly the true ones, tho' not preciſely, as I intend hereafter to ſhew. And if I underſtand him aright he muſt mean as Mr. KEILL does, tho' ſo very different from him both in Time and Expreſſion; for the latter Gentleman ſays, that theſe Times are the 4th of *April*, the 16th of *June*, the 20th of *Auguſt*, and the 13th of *December*. Mr. KEILL calls the True and Equal Time all one; but we find Mr. DE CAILLE uſes the True for the Apparent Time, and oppoſes it to the Mean or Equal; and I think very juſtly; for is it not truly and really Noon when the Sun is on the Meridian? Now it is very manifeſt that KEILL and CAILLE differ vaſtly in this Matter, and it is as clear that they cannot both be right; but if they built on true Principles they could not thus diſagree, which ſhews ſome Defect or Error, and deſerves Remark.

To ſay the Equation of Time conſiſts of Two Parts is not accounting for or explaining any of the Difficulties; neither is it any more than the Difference between the Sun's true Longitude and right Aſcenſion; as TYCHO and STREET have rightly defined it, in their Way; i. e. I mean, according to our preſent Aſtronomy. Nor is it ſtrictly Mathematical to imagine the Sun to move along the Ecliptic inſtead of the Earth, as our Aſtronomers do in explaining this Matter. Dr. GREGORY's ſuppoſing one Sun to move in the Equinoctial and another in the Ecliptic, with equal Motion, is not in any wiſe ſufficient, neither natural, or at all to the Purpoſe, to account for the true Difference of the Motions of Clocks, and the Sun or Earth: Nor is there any Regard paid by him to the Earth's Elliptical Orbit, as the Sun's being nearer to it one Time than another: In fine, I do not ſcruple to ſay, that both his and Mr. KEILL's Illuſtrations are no way pertinent to, or connected with, the Matter of which I am now ſpeaking, but the moſt remote for a Mathematic Demonſtration I ever ſaw; nor do I think any Mathematician can juſtify either of their Proceedings. Why muſt we ſuppoſe what is not, i. e. Two Bodies to move in Circles to procure a Demonſtration, when there is in Reality but One that moves, and that very Body that really does is ſuppoſed to be quieſcent, and vice verſa? And tho' 'tis allowed that the Earth deſcribes an Ellipſis, yet the Inveſtigation is drawn from a Circle.

All Bodies or Things ſhould be repreſented as they really are, before the Enquiry is made for Truth; for otherwiſe we ſhall deceive ourſelves in the Demonſtrations, and perhaps lead others aſtray. The Difficulties our Aſtronomers are put to in explaining in what Points the Equation of Time is the greateſt, by drawing Hyperbolic Curves, &c. are almoſt ſufficient to make a reaſonable Enquirer to ſuſpect the Truth of our received Syſtem: But in mine none of theſe Intricacies appear.

Our Aſtronomers in the afore-mentioned Caſe make uſe of the Arch of the Ecliptic Line as a great Circle in all Reſpects, and is ſo drawn on all our Globes, altho' that one Part of the tranſverſe Axis of the Earth's Elliptic Orbit from the Plane of the Æquinoctial, where the Sun muſt be ſeated, will be almoſt Three Millions of Miles longer than the other; and yet our

Moderns maintain that the Sun's greateſt North Declination is but juſt equal to his South, which is abſurd on our Hypotheſis (But the ſame is certainly true, I moſt ſtrongly preſume).

Let the Line Æ Q (Fig. 2.) repreſent the Equinoctial, N S the Ecliptic, and $\odot$ the Sun; then the Line N $\odot$ will be greater than S $\odot$ by almoſt Three Millions of Miles, conſequently the Sun's greateſt Declination on one Side as N Q will exceed the other Æ S by D N (making $\odot S = \odot C$) p^{r}. ſimilar Triangles.

If the Curious ſhould object and ſay, that an Ellipſis may poſſibly be ſuch as that the Semi-Ordinate S $\odot$ (drawn from the Sun, Fig. 1.) may be juſt equal to the Abſciſſa $\odot$ P, and that then there may be four Times in the Year when Clocks and Sun-Dials would keep Time together; I anſwer, that, if ſo, this great Abſurdity will follow, viz. That the Earth would be nearer the Sun moſt Part of the Time from P to S, than from the Perihelion itſelf, and the like on the other Side of the Orbit from P to D; which would manifeſtly contradict, and entirely overthrow, the whole Syſtem; and the Sun's Diameter (according to our Aſtronomy) would appear greater in *February* and *November* than when the Sun is at P. That the Truth of the Aſſertion may fully appear I have inveſtigated the following Demonſtration.

DEMONSTRATION.

PUT $4a = S\odot$ = a Semi-Ordinate $= \odot P$ an Abſciſſa = Radius, which deſcribes the Arch, S R P the Quadrant of a Circle; $5a$ = the Abſciſſa $A\odot$; and $\odot Q = QP = 2a$: Then p^{r}. Property of the Circle $HQ = 6a \times QP = 2a = 12aa = RQ^{\square}$; and p^{r}. Property of the Ellipſis ſay, as $A\odot = 5a \times \odot P = 4a : S\odot^{\square} = 16aa :: AQ = 7a \times QP = 2a : 11.2aa = Qr^{\square}$; which is leſs than $RQ^{\square}$ by ,8 aa. Q.E.D.

One Thing is remarkable, viz. That our Aſtronomers make the Equation of Time greater in *October* than in any other Month, which ſeemingly exhibits ſome Irregularity in Nature; for why ſhould there not be the ſame Exceſs in the oppoſite Part of the Orbit, as an Ellipſis is a regular Figure? And this gives me ſome Reaſon to believe, that our Aſtronomers do not ſet Clocks with the Sun at the right Times of the Year; and therefore may occaſion ſome Difference. If a good Time-Piece was ſet with the Sun at right Times, I make no Doubt but there would be great Exactneſs in the two greateſt Equations.

Had our Aſtronomers ever nicely examined the Elliptic Figure of the Earth's Orbit, and have obſerved truly the Nature of her ſuppoſed Motion, viz. That ſhe moves about a Fifteenth Part faſter in Winter than in Summer, i. e. 61' in Perihelion, and 57' in Aphelion, as pr. KEILL, P. 272, and then have compared theſe Things with the Tables of the Equation of natural Days, (and I ſuppoſe FLAMSTEAD's are as correct as any yet extant) I imagine they might have diſcovered the Contradictorineſs of the Motions with the Tables. For Inſtance: The Tables inform us, that about the 22d of *October* Clocks are too ſlow by 1'6, or that the Earth has got beyond equal Time ſo many Minutes; and yet they ſhew, that about the 13th of *December* that equal Time has overtaken the (Sun or) Earth, notwithſtanding ſhe is nearly in her ſwifteſt Motion! Nay, what is ſtill ſo amazing as the former is, that about the 30th of *January*, a Clock, or equal Time-Piece, has gained 14' 59" of the Earth, altho' ſhe is in her ſwifteſt Motion. But, ſtrange and inconſiſtent as it is, this is our received Doctrine; which I think I might challenge any Mathematician to vindicate on the preſent Principles of Aſtronomy. And if he cannot, this Chapter of itſelf is ſufficient, I imagine, to overthrow the preſent received Syſtem. And I muſt add, that notwithſtanding our Aſtronomers aſſert that the Earth moves faſteſt in our Winter and ſloweſt in our Summer; I don't remember that I ever ſaw any Proof of it, nor ſcarce a Shadow; which, I preſume, is abſolutely neceſſary for an Antagoniſt to ſhew.

Indeed Mr. KEILL ſays (P. 82), " In our Summer the Sun is obſerved to go with a ſlower Motion, and in our Winter he moves ſomewhat faſter, &c. on which Account the Sun is obſerved to ſpend near Eight Days more Time in the Northern Signs than in the Southern." But I am poſitive this is no Manner of Proof whatſoever, as will appear by inſpecting Fig. 7: For if the Sun be ſeated in the Plane of the Equinoctial, as is allowed, and E repreſents the Eaſt and W the Weſt, the Abſciſſa ⊙ S will be greater than ⊙ N by about 2.745.000 Miles, and conſequently the Periphery or Arch B S C, will require longer Time to be paſſed over than the Arch B N C, ſuppoſing uniform and equable Motion. But this Gentleman ſays, in the ſame Page, that " The apparent Motion of the Sun in the Ecliptic cannot be regular and uniform;" and in the next Page ſays, " That the unequal Motion of the Sun or Earth is not ſo in Reality, but only optical and apparent." And 'tis ſaid, Pa. 272, That if the Earth deſcribed equal Angles round the Sun in equal Times, the apparent Motion of the Sun would always be equal. Now what can a Reader determine from theſe contradictory Expreſſions?

The next Page he ſays, that the Motion of the Sun thro' the Ecliptic is obſerved by taking Meridian Altitudes; which doubtleſs is true, could it be accurately taken every Day in the Year; and alſo if the exact Quantity of Refraction at all Altitudes was known: But the former we cannot ever expect to obtain, and the latter yet is extremely doubtful.

Whenever the Earth moves faſteſt in her annual Motion, at that very ſame Time and Place ſhe will alſo revolve faſteſt about her Axis, or in her diurnal one; as will quickly appear, I preſume, from the Conſideration of the Fifteenth Lecture of Mr. KEILL's Introduction to Natural Philoſophy; or otherwiſe from EMERSON's Mechanics; from whence, if we find any fixed Star on the Meridian at a certain Time one Night, we ſhall, by a good Time-Piece, the next Night, truly and eaſily diſcover the Difference of the Earth's Motion in Summer and Winter, if any there be; but I imagine no Difference was ever yet, or ever will be, found at theſe Times. And this new Method I take to be infinitely preferable to any other ever yet practiſed to find the Difference of the Earth's Motion in Summer and Winter.

One Thing more I cannot help obſerving concerning equal and apparent Time, and do here openly, and without any Diſguiſe, ſay, that I ſincerely believe, that not one of our Aſtronomers ever compared our Tables of the Equation of Time with the Earth's Motion in her Orbit; for if they had, it cannot but be they would have diſcovered the Incon~~ven~~sistency and Impoſſibility of their Agreement; for the Earth's Eccentricity is ſo ſmall in this Reſpect, that the Orbit would not be very different from a Circle. They ſay, that the Four Times in the Year when the Sun and Clocks would keep Time together are, *April* 4, *June* 6, *Auguſt* 20, and *December* 13: Now obſerve, that from *April* 4 to *June* 6, which is but 63 Days, the Sun gains of Clocks, ~~during which Time~~, from *June* 6 to *Auguſt* 20 is 75 Days, the Sun loſes of Clocks; from *Auguſt* 20 to *December* 13 the Sun again continually gains Time of Clocks, which is 115 Days, and from *December* 13 to *April* 4, which is 112 Days, the Sun again loſes Time: Now I ſhould be extremely glad to know (if any Aſtronomer can tell me) from whence ſuch ſtrange and amazing Irregularity can proceed? Not from the Motion of the Earth I am poſitive. I believe I might venture to reſt the whole Diſpute concerning the Truth or Falſity of the received Syſtem on this One Chapter. But to give a full Blow to our received Syſtem of Aſtronomy at once, and for ever explode it hereafter. I ſhall now give the following brief, but I imagine, full and clear Demonſtration.

If our Earth rolls along the Ecliptic as is allowed, which croſſes the Equinoctial in an Angle of 23° $\frac{1}{2}$, and the Sun's mean Diſtance be from us about 81 Millions of Miles, then the Earth's Orbit will be about 162 Millions of Miles in Length, as modern Aſtronomers allow; now p^{r}. Trig. it is eaſy to find that the Earth will be ſometimes above 32 Millions of Miles on the North Side of the Equinoctial, and ſometimes the like Diſtance on the South Side of it, or 23° $\frac{1}{2}$ on the Globe, whence the fixed Stars when in the Zenith to an Equatorean in our Winter and Summer moſt manifeſtly differ above 64 Millions of Miles, or what our Globes mark out for 47°. *i. e.* any fixed Star which is in the Zenith to an Inhabitant in the Equator in *December*, will be above 64 Millions of Miles more ſoutherly in *June* than then; and let the Stars Diſtance be ever ſo immenſely great, it is no Manner of Service to or Refuge for our Aſtronomers whatſoever, becauſe our Inſtruments are now ſo accurately made, as to tell to a Second; and their Situation or Direction in this Caſe, will be parallel both in our Summer and Winter. And the Earth's Axis not only preſerves a Paralleliſm as to North and South, but likewiſe to One Horizon, and is always parallel to itſelf; But no ſenſible Difference as to the Stars ever yet appeared to any Obſerver either in England or at the Equator, for the very ſame Stars which are in the Zenith at One Time of the Year will be ſo throughout the whole Year, and this no Perſon can preſume to deny. From whence, it evidently and undeniably appears, I think, that the Earth rolls preciſely in the Equinoctial with her Axis perpendicular to the Plane thereof, which moſt beautifully exhibits the Wiſdom and Maſterlineſs, if I may ſo ſpeak, of the great Creator, and baniſhes the bungling and unnatural Conjectures of Man; for we know that Nature is pleas'd with or delights in Simplicity, and that ſhe does Nothing in vain, as Sir ISAAC ſays in his firſt Rule for reaſoning in Philoſophy:

ILLUSTRATION of this Matter.

LET ÆBQRZ (Fig. 4 Pl. 4) repreſent the Plane of the Equinoctial, A the utmoſt Diſtance of the Earth from it in our Winter, and C the Diſtance in Summer, and DE = CE = 32 Millions of Miles: Now becauſe the Equatoreal Diameter of the Earth keeps a continual Paralleliſm to itſelf, it will follow that when the Earth is at B, the Diameter will point to the Stars in the Zenith whether at QR or Z; when the Earth is at A, it will then point to the Zenith Stars, whether P, H, G, F, or N; and when at C then to I, K, or S; and if One of the Stars ſhould be at P and the other at S, i. e. be they at what Diſtance ſoever, and either equal or unequal from the Earth, their normal Diſtance from the Equinoctial muſt be = DC = 64 Millions of Miles, tho' their real Diſtance may be Ten Thouſand Millions &c: and this is infallibly true, viz. that the Space PI or NS &c. muſt be 64 Millions at leaſt beſides our Sun's Axis. Now let us ſuppoſe each Star to be of equal Magnitude with our Sun, then there muſt be Room in the forementioned Spaces to contain about 84 Stars, directly from North to South in the Heavens as big as our Sun, conſequently the Zenith in Winter muſt ſo much differ from that in Summer. What Angle DZC, or the Space DC would make to an Obſerver ſo far off as a fixed Star, is not in any wiſe the Thing in Diſpute, as muſt vnavoidably appear to any Mathematician on an impartial and ſtrict Enquiry.

Now altho' I think this Argument to be unanſwerable, yet I ſhall produce divers others to corroborate it, which follow.

CHAPTER III.

Of the Motion of our Earth.

ALL Motion or Change of Place ſhould be performed in the ſhorteſt and eaſieſt Manner the Nature of the Path will admit of, and if it is not ſo, Nature ſeems to labour in vain, which a true Philoſopher cannot juſtly allow. That our Earth ſhould revolve about its Axis from Weſt to Eaſt, and yet always continue in the Ecliptic Line, which is contrary and obliquely to the natural Path, in which ſhe revolves about her Axis, is ſuch a forced and unnatural Motion as I never yet ſaw in any conſtantly-moving Body; and I believe I may ſafely and undauntedly challenge all the Artiſts in Europe to puſh on a Body in ſuch a Manner as our unweildy Globe is ſuppoſed to roll.

Our much praiſed Orreries are extremely imperfect I preſume, there ſcarce being Two Motions truly exhibited. And it is very remarkable that Jupiter ſhould revolve about his Axis in an Orrery, as he really does, and our Earth not do ſo: It looks to me as if it was deſigned to impoſe and deceive every ignorant Beholder, becauſe by ſeeing Jupiter revolve ſo, it may be inſinuated that our Earth accurately does the ſame; but the curious Enquirer will ſoon diſcover the Fraud and Imperfection, I imagine, could an Artiſt make a Body revolve as our Earth is ſuppoſed to do, he certainly would, in order to diſplay his extraordinary Skill.

And our Cœleſtial Globes are very unnatural I humbly conceive. The Secondaries always appear ſo aukward to me, that I am always diſpleaſed (and as it were in Pain) when I obſerve their oblique and wambling Situation, when revolving about the Poles of the Equinoctial. Was the Globe to revolve about the Poles of the Ecliptic, their Poſition then would be very natural, but cannot be ſo if otherwiſe. I cannot ſee any Reaſon for, or

Propriety in, ſaying or imagining that the Ecliptic has any Poles; becauſe there is Nothing ſuppoſed to revolve thereon. For our Earth which, Aſtronomers now ſay, moves along the Ecliptic Line, is univerſally allow'd to roll on the Poles of the Equinoctial: And it cannot be ſuppoſed that the Præceſſion of the Equinoxes is owing to any Motion of the fixed Stars, but to ſome Motion of our Earth, or rather the Change of its Orbit; the which I ſhall largely diſcourſe on in its proper Place. And ſhall alſo attempt to demonſtrate that the Earth is always in the Equinoctial; and if ſo it will be much more eaſy and natural to reckon the Latitude of the fixed Stars from this Line than from the Ecliptic, as is now practiſed, and ſo blend Declination with Latitude or make them ſynonymous Terms.

It is poſſible for an Artiſt to cauſe a Body to move round a Hoop, or Wire, &c. and turn on in its Axis alſo, if the Axis is at Right Angles with the Orbit, as is well known, but not in the Poſition our Earth is ſuppoſed to be, I imagine. I could wiſh our Aſtronomers would try the Experiment of a Globe or a Body reſembling our Earth revolving about a circular Hoop, &c. which ſhould repreſent the Ecliptic and in ſuch a Manner as our Earth is ſuppoſed to move, i. e. with its Axis always parallel to itſelf, and curiouſly obſerve the Aukwardneſs, the Strugglings, and the Irregularity of the Whirling, and then ingenuouſly confeſs whether they really think any Body in the Univerſe has ſuch an unnatural and difficult Motion or not: Sometimes you will obſerve that the Convexity of the Earth at the Equator will touch and roll on the Convexity of the Hoop; ſometimes that Part of the Globe to the South of the Equator, and ſometimes that Part on the North Side of the Equator, will touch and whirl on the Hoop, &c. I cannot think that a good Naturaliſt will after a thorough Conſideration ſay that he actually believes our Earth has ſuch a Motion. Nay I freely declare that I think that there is no ſuch continued Motion either in Heaven or Earth. And our Aſtronomers ſay there needs no third Motion to be feigned to account for ſuch a threefold or compounded one; and for a Demonſtration of the Probability of it, Mr. KEILL ſays, Pag. 66. that all the Diameters of the Body, except the Axis, will conſtantly change their Poſition by this Rotation. What Proof this is I freely confeſs I am at a Loſs to know; nay is it intelligible, and to any Purpoſe? I think to eſtabliſh ſuch a compounded and unnatural Motion as our Earth is ſuppoſed to have, more Words or Demonſtrations would be abſolutely neceſſary. For if a Wheel or Globe in One fixed Place turns round its Axis once in a Day, is that not ſtrictly a diurnal Motion? And if there be added another Motion to carry it round an Orbit once in a Year, is not that a real annual Motion? And thirdly, if this Globe is driven in a contrary Direction to that which it would naturally go or move in, muſt not this third Motion be a projectile One, and different from either of the former Two? The Explanation of the Earth's Motion by this laſt mentioned Gentleman p. 72, I fancy the Reader will think very unnatural, and too troubleſome to correſpond with Nature. I think it likewiſe neceſſary to obſerve that FERGUSON, a late Author, in Order to exhibit the Viciſſitudes of the Seaſons, has endeavoured to give a threefold Motion to a Ball by twiſting a String hard which is faſtened to it, and ſuffering it to unbend itſelf; and whilſt that is doing, to carry it round by ſome ſteady Hand about a Hoop and raiſing it up and depreſſing it, &c. which at firſt Sight is pleaſing enough I own; but when the Motion is truly conſidered, you will find it much too bungling for even the Author himſelf to imagine the Earth to have ſuch a Motion, nor do I ſuppoſe he thinks ſo. But farther, when this String is untwiſted, and arrived to its natural State or Order, it will, by the Force it has obtain'd, twiſt itſelf the other Way of the String until the firſt apparent Motion is quite ſtopped by Degrees, and then the Ball will have a quite contrary Motion, and revolve backwards with different Degrees of Velocity, which our Earth is not obſerved to do; nor ever from Eaſt to Weſt, unleſs the Reader will pretend to give Credit to the Aſſertions of HERODOTUS and PLATO, which, I preſume, no Aſtronomer will.

The Reaſon why our Aſtronomers adhere to this unnatural Motion of our Earth is, becauſe they cannot account for Summer and Winter any other Way; tho' I very clearly can, as will be hereafter ſhewn. Now they themſelves allow Great Jupiter to move on in his Orbit with his Axis perpendicular to the Plane thereof (or very nearly), and alſo Mars; and why they would imagine a Siſter Planet to move ſo very different, and make ſuch a troubleſome, oblique, difficult, nay I could almoſt ſay impoſſible Journey, is ſomewhat very remarkable, as well as unaccountable: Not that I ſay Omnipotence is incapable of giving a Body ſuch a Motion and Whirlings: Yet I cannot but think that an All-wiſe Being would contrive Things in the eaſieſt and ſhorteſt Way, for therein conſiſt the Beauty and Wiſdom of the Operator. Under the Belief of the preſent received Hypotheſis, particularly that Part of it which repreſents the unnatural, difficult, and ſtruggling Motions of our Earth, I ſhould not at all wonder to hear one of the Alphonſian Tribe (I mean one who is truely acquainted with Nature) cry out in this or the like Exclamation, viz. Had the Great Creator conſulted him in framing this Planetary Syſtem, he could have inſtructed him how to have done it better. And this, I humbly preſume, is ſo far from being a blaſphemous Expreſſion, that, on the contrary, it moſt prudently ſhews the great Diſtinction he makes between the bungling Imaginations of imperfect Man, and the real Wiſdom of a perfectly-wiſe and omnipotent Being.

If an unbiaſs'd Bowl is thrown direct along the Ground, it will go on in a ſtrait Line with its Axis perpendicular to its Path, if not interrupted by the Unevenneſs of the Plain, and cannot poſſibly be otherwiſe.

There is another Kind of Motion, which is very natural and eaſy when a Body has a Bias or Propenſity to ſome certain Place or Point; which I ſhall have Occaſion to explain when I diſcourſe of the Moon.

Now, if I can demonſtrate that the Earth may have ſuch an eaſy Motion as juſt above mentioned, and move in a circular Orbit, or at leaſt not differ from it any more than is occaſioned by the Force of Gravity or Attraction, or the different Diſtances of the Sun and Moon from the Earth, and yet account for all the Cæleſtial and Terreſtrial Phœnomena, I conceive it will be a conſiderable Step towards the Overthrow of the preſent received Syſtem.

And if our Earth moves in the Manner I imagine, the Sun's Diſtance from us may not be One Million and half of Miles; for the whole Earth's Orbit will not exceed 365,25 Times the Periphery of our Earth, unleſs ſhe has a projectile Motion; and if ſo, the Difficulties or Objections which have been raiſed about the annual Parallax will entirely ceaſe: For is it not moſt amazing that no Difference ſhould be diſcovered in the Pointing of the Poles of the World amongſt the fixed Stars (let them be ever ſo diſtant) at different Times of the Year, if our Earth's Orbit was in Diameter One Hundred Sixty-three Millions of Miles!

'Tis well known that a great Number of ſkilful Aſtronomers thought all Bodies muſt move in perfect Circles, it being moſt natural: And our Moderns aſſert, that the Satellites of Jupiter and Saturn move in circular Orbits, or very nearly; and yet they are forced to acknowledge, that theſe Attendants revolve about their Maſters by the ſame Law that they themſelves do about the Sun. And many of our Great Authors believe, that all the Planets did really move in perfectly-circular Orbits at the Creation. But if they were at firſt ſet ſo by the Almighty, certainly the Nature of the Frame and Revolutions muſt be acknowledged to be indiſputably right, and perfectly compleat: And if ſo, why ſhould this beautiful Frame and Order be deſtroy'd? It cannot be ſuppoſed that the Creator is unable to ſupport his Workmanſhip, if it may be ſo called.

If the Sun is fixed, and had only our Earth to revolve about him, I ſhould be glad to know from any Newtonian, what good Reaſons can be given that it would deſcribe an Elliptical Orbit? I know Sir ISAAC, Prop. 13, Theorem. 13, intimates that it would: But as the Spaces all around him, at equal Diſtances, muſt be (I ſtrongly preſume) allow'd to be ſimilar in all Reſpects whatſoever, nay we cannot ſuppoſe otherwiſe reaſonably, how can, or why ſhould, Bodies act, or be acted upon, differently or more ſtrongly in one Part or Place, equidiſtant, than another?

And it is univerſally allowed, that the projectile Force of any Body may be ſo nicely adapted and contempered to the Quantity of the Sun's Attraction, as that the Orbit may be a perfect Circle: And ſince it is thus, why ſhould we think an Almighty and Uniform Being would not do ſo? He certainly did perform all Things in the moſt perfect Way poſſible.

The Reaſon why Aſtronomers believe the Planets Orbits to be Elliptical is, becauſe they cannot account for all Appearances if they were circular. The Determination of the Orbits of Planets or Comets by Obſervations in this Kingdom alone, is not any way to be depended on, as will be hereafter clearly demonſtrated: For, to make a Diſcovery by Obſervations taken in one Place only, the Equator is infinitely preferable to any other. A right Line may appear as a Circle in the Heavens, and a Circle may appear as a right Line; the Convexity of an Orbit as the Concavity; and a Circle may exhibit divers Sorts of Ellipſes; ſome nearly circular, others very eccentric; and Parts of Circles may appear as Parabolas or Hyperbolas in the Heavens, if theſe Parts exceed not Semi-Circles: But there can be no Parabolic or Hyperbolic Orbits in Reality, tho' ſo often mentioned, and ſo long dwelt upon by our greateſt Authors; for a Planet would never return or come back again to any of the Places it ever was before, as muſt be allow'd by every Mathematician who underſtands the Properties of thoſe Curves; for they are the whole Sections of a Cone, as a Triangle, Circle, and Ellipſis are. Then, ſince it is ſo, why ſhould our Aſtronomers take ſo much Pains, protract ſo many Schemes, and give ſo many laborious and learned Mathematic Demonſtrations, about theſe Figures, or even mention the Name of Hyperbola or Parabola; as their Properties are already well known and explained by a great Number of Writers on Conic Sections?

If a Body ſhould move with a perfectly equable Velocity throughout a whole circular Orbit, it cannot poſſibly appear ſo to us, let the Poſition of the Circle be what it will, unleſs we were at Reſt, and nearly in the Centre of the Orbit, or perpendicular to the Plane thereof, which muſt then be Horizontal: For we cannot by Obſervations alone determine truly when a Planet moves faſteſt or ſloweſt. We frequently obſerve a Planet to appear ſtationary, tho' in actual Motion, and even ſometimes to appear to move exactly the contrary Way it really does.

The ſaying that there is a Force called the Centripetal, which prevents a projected Body from going on in a right Line; and that there is likewiſe a Centrifugal one, which endeavours to proceed ſo; and that they are contrary and equal, like Action and Re-action; is not Philoſophizing at all Mathematically, nor of any manner of Uſe whatſoever in Aſtronomy.

But further: The bare aſſerting that a Body, projected with a greater Velocity than what is allow'd, will deſcribe a circular Orbit, which is the Velocity a Body would obtain in falling from Half the Radius of that circular Orbit, will form an Ellipſis greater than the Circle; and when with leſs Swiftneſs a leſſer Ellipſis than the Circle, is not in any wiſe ſufficient. And our Aſtronomers, I think, take the very great Thing for granted, which requires the fulleſt Demonſtration either of the Poſſibility or Probability of it, viz. That a Body will deſcribe an Ellipſis about one fixed central Power. Were there two Suns placed at ſome Diſtance from one another, I make no doubt but a projected Body would deſcribe an Elliptical Orbit around them, reſpecting them, and ſurrounding, as the Periphery of an Ellipſe does the Foci thereof, but not otherwiſe.

They alſo ſuppoſe a Body may be projected, and not in its own Tangent, and even aſcending from, or deſcending to, the central Body or Power; whereas in Fact there is no ſuch Thing; for from the Center every Way equally diſtant is alike in all Reſpects, and the Projection muſt be a Tangent to ſome Circle, let it be projected any where or how, provided it is not in a right-lined Direction towards the Sun or Center, as is clearly exhibited by Inſpection only.--- Vide Fig. 3. Plate I. & p. 95.

CHAPTER IV.

Of the unequal Length of our Summer and Winter, &c.

IF the Sun really tarries eight Days longer on the North Side of the Equinoctial than on the South, or the Earth on the South Side thereof, as all our Aſtronomers affirm; and if the

Earth moves faſter in our Winter than in Summer; theſe Enormities will unavoidably follow, viz. That our Antipodes, and all thoſe whoſe South Latitude is equal to our North Latitude, will have their Winter eight Days longer than their Summer, altho' our Summer is eight Days longer than our Winter; and the Earth will move faſteſt in our Winter, and faſteſt in their Summer; and the Sun will be neareſt to us in our Winter, and neareſt to them in their Summer; for our ſmall Diſtance from one another, which may be about Six or Seven Thouſand Miles, will make no ſenſible Difference when we compare it with the ſuppoſed ſurprizing Diſtance of the Sun from us, it being 81 Millions of Miles: For the whole Earth can be but as a ~~Mathematical~~ Point in this Reſpect; whence it is quite impoſſible that the Sun can be neareſt to us, and fartheſt from our Antipodes, at one and the ſame Time, as it ſhould be to correſpond with our Aſtronomers Reaſons for Summer and Winter.

The above Occurrences ſeem a very odd and irregular Contrivance, and cannot, I think, be reaſonably accounted for by any Arguments whatſoever; for the Sun, by the preſent Syſtem, will be nearer the Earth in *December* than in *June* by about 2.754.000 Miles. But further, it muſt not paſs by unobſerv'd, that the Reaſon our Aſtronomers give for the extraordinary Heat we receive in our Summer, and for the Cold in Winter, will not at all ſerve for our Antipodes, &c. for they actually muſt have the Sun neareſt them in their Summer by the preſent Syſtem, and furtheſt from them in their Winter; which is directly contrary to our Reaſons for our Summer and Winter; but theirs are the true Reaſons, beyond all Diſpute, to me, for the Difference of the Seaſons; as I intend fully to ſhew in its proper Place.

Is it not extremely odd, or irregular, that our Antipodes ſhould have the Sun almoſt 3.000.000 of Miles nearer them in their Summer than we have in ours? And alſo be the like Diſtance further from him in their Winter than we are in ours? It certainly cannot be ſo in Reality: No Reaſon can be found for ſuch different Diſtances in the ſame Caſe.

From the above, we muſt conclude, from our modern Aſtronomy, that our Antipodes Summer is vaſtly hotter than ours on this Footing, they having the Sun not only ſome Millions of Miles nearer than we have, but likewiſe the Rays fall with the ſame Obliquity preciſely as here in *England*, i. e. the ſame Number of Rays in the ſame Area.

But further; Mr. SYMPSON, late F. R. S. in his Treatiſe of Fluxions, Problem 19th, has this following Corollary drawn from it very much to my Purpoſe, which I here tranſcribe verbatim, leſt all my Readers ſhould not have it: Hence (ſays he) it is manifeſt that as much Light and Heat fall on the Earth while the Sun is on the South Side of the Equator, as while he continues on the other Side, and vice verſa. And alſo, that in all Places having the ſame Degrees of Latitude, whether Northerly or Southerly, the Quantity of Heat or Number of Rays falling from the Sun in one whole Year will be the ſame.

Now, if it be ſo, as doubtleſs it is, how can it be reconciled with our received Hypotheſis? If any Antagoniſt appears, I muſt deſire he would attempt to diſprove the Problem from whence this Corollary was gained.

Again, It muſt be obſerved, that an Inhabitant at the North Pole will have this Day eight of our Days and Nights longer than an Inhabitant at the South Pole, on our Aſtronomers Doctrine, which ſeems unequitable, for Summer is certainly preferable to Winter: Alſo an Equatorean will have the Sun eight Days more on the North Side of his Zenith than on the South Side; and this ſcorching Luminary will be almoſt Three

Millions of Miles nearer to him in *December* than in *June*. But, I ſtrongly preſume, not one Perſon living ever found ſuch Difference there in the Heat in *June* and *December*, as this Difference of Diſtances muſt actually cauſe; neither do I believe that it ever was obſerved there that the Sun tarried Eight Days longer on the North Side of the Zenith than on the South Side. If it is ſo, I ſhould deſire to have ſome kind of Proof or other from Authority, and not from any Obſervations in this Kingdom, for Ten Thouſand taken here are in no wiſe ſufficient to prove the Aſſertion, as I ſhall hereafter demonſtrate. Theſe Appearances here are Deceptions, and owing to ſome Cauſes which hitherto have not been truly explained. And I make not the leaſt Doubt but our Antipodes would aſſert, that their Summer is Eight Days longer than their Winter. From whence we may juſtly admire the Wiſdom, and remark the extreme Kindneſs of our Omnipotent Benefactor in giving us an Atmoſphere; for by it our Summer is lengthened as well as every Day.

I would aſk an Artiſt that is ſkilled in Machinery, if he had been to frame ſuch kind of a Machine as our Syſtem, whether he would not have contrived every Thing more juſtly and accurately than this our received Syſtem is deſcribed or imagined to be? I make no doubt but he would ſay Yes. Then, if he could, why ſhould we imagine this Frame is not nicely compoſed? It undoubtedly is, and the Workmanſhip truly worthy its Divine Architect. By my imaginary Syſtem, an Inhabitant at the North Pole will have the ſame Length of Day as One at the South Pole, and conſequently the ſame Heat, &c. And an Inhabitant at the Equator will have the Sun ſo near him in *June* as in *December*, and ſo long on one Side his Zenith as the other Side. And we in this Kingdom ſhall be further from the Sun in our Winter than in Summer; and our Antipodes alſo the very ſame, i. e. nearer the Sun in their Summer, and further from him in their Winter; and I make not the leaſt doubt but thoſe Things are really ſo, and will hereafter be found true.

CHAPTER V.

Of the Moon.

THAT the Moon is a conſtant Attendant on our Earth is indiſputable; but her Orb and Manner of Revolution are both yet doubtful, and undetermined, I preſume. The numerous and unaccountable Intricacies which are to be combated with, give many and juſt Reaſons for a Naturaliſt to ſuſpect that her Theory is not grounded on Truth or Reaſon; her Motions, &c. being too troubleſome to correſpond with Nature, becauſe ſhe univerſally does Things the eaſieſt Way. But all our Aſtronomers are obliged to confeſs, that her Path is the moſt difficult to be traced of any other Planet whatſoever. And altho' they have juſtly exploded the ridiculous Epicycles of the ancient Syſtems, they are obliged to call in One to give a Solution to the Phœnomena of this Secondary, which ſhews they are much puzzled with ~~their~~ her various Motions and ſeeming Irregularities.

There is ſomething in her conſtant and regular, which is, That ſhe turns juſt once round her Axis in one Revolution about the Earth, and always exhibits to us nearly the ſame Face; for which Phœnomenon various Reaſons are aſſigned by our Aſtronomers. Sir ISAAC ſays, Prop. 38, Prob. 19, That the Figure of the Moon will be a Spheroid, whoſe greateſt Diameter produced will paſs through the Centre of the Earth; and ſays, that is the Reaſon the ſame Face of the Moon always reſpects the Earth.

Other great Aſtronomers ſay the Reaſon is, becauſe ſhe revolves about her Axis preciſely once in one Revolution about the Earth. Now certainly both theſe Reaſons cannot be juſt, becauſe they differ vaſtly; and perhaps neither is the true one. As to the latter, whether ſhe revolves about her Axis once, or one hundred Times, it would not alter the Caſe; which muſt appear plainly to any Mathematician that will attentively conſider it, without any formal Demonſtration. But it may be illuſtrated in ſome Meaſure in theſe few Words, viz. If a Perſon was ſituated ſo as ~~the~~ a Globe may roll horizontally all around him at ſome convenient Diſtance (he being in the Center) and with the Globe's Axis parallel to the Horizon, the ſame Face would continually exhibit itſelf to that Perſon beyond all Doubt, whether the Revolutions be many or few.

As to Sir ISAAC's Aſſertion, I ſay thus, viz. It is univerſally allowed, that the Polar Diameters of all the Planets, whether Primary or Secondary, are leſs or ſhorter than the other, or Equatoreal Diameters, and we know our Earth's to be actually ſo; and the Equatoreal Diameter of the Moon is acknowledged to be 186 Feet more than its Polar Diameter: Whence it will follow, from the Nature and Poſition of ſuch a Rotation, that in the Space of one entire Revolution of the Moon about the Earth, we ſhould ſee all the Parts of her Superficies, fere; which contradicts all Obſervations, for we never did ſee more than about one half thereof: And an Inhabitant at the Equator would ſee juſt the ſame Hemiſphere. Whence it appears, that I muſt either be miſtaken in my Remarks and Ideas, or the Tracts and Opinions of the Learned muſt be erroneous; which of theſe I ſhall leave the curious and impartial Readers (of which I hope there are many) to determine.

I have already hinted that the Motion of the Moon is not the ſame as that of our Earth, but very different and oppoſite;

for inſtead of its Axis being normal to the Plane of its Orbit, as Jupiter's is, and Mars's alſo, (and every primary Planet doubtleſs revolves alike) I have great Reaſons to believe it to be preciſely coincident with it; and, to explain myſelf, I give the following

ILLUSTRATIONS.

LET ☉ be a fixed Iron (Pl. I. Fig. 4.), and ſomewhat above a Horizontal Plane, and a Globe as M at one End of a Rod, which is confined at ☉, which I here ſubſtitute in the room of Attraction, or Gravity, to prevent M from flying off in a Tangent; and let the Rod go thro' the Centre of the Ball M, ſo as the Ball may be capable of turning round the Rod as its Axis: Now, if you give the Ball a Thruſt or Blow, it will move about the Circle M M M untill the Force is deſtroyed, and will naturally and unavoidably exhibit the very ſame Face towards ☉, let the Revolutions of the Ball be many or few.

Now let us ſuppoſe ☉ to be our Earth or its Center, or the Central-Power of the Moon M, which revolves about our Earth; and whether the latter moves in an Orbit, or is at Reſt, it makes no Difference in this Caſe: And alſo let us ſuppoſe the Earth's Attraction juſt ſtrong enough to keep the Moon from flying off, and that ſhe is confin'd by that Power as it were by a Chain, from which it cannot be releaſed; then if — — — — — — — the Moon be projected, with its Axis pointing to the Earth, along the Tangent A B, ſo as ſhe ſhall deſcribe a Circle about the Earth, it is manifeſt that the Part which ſhews itſelf to the Earth will be always invariably the ſame, fere, and its Axis coincident with the Plane of its Orbit, which is both quite natural and eaſy, and is no way difficult, bungling, or troubleſome: And I could venture almoſt to affirm, that none of the Heavenly Bodies deſcribe Orbits any other way than by their Axis being either perpendicular to, or coincident with, the Planes, notwithſtanding Aſtronomers give our Earth ſuch an oblique and unnatural Motion; but they are obliged to adhere to ſuch a Motion, for otherwiſe they cannot account for the Viciſſitudes of the Seaſons: But I can; and yet the Earth ſhall travel her Orbit with the Axis perpendicular to its Plane: And this coincident Motion ſeem the Satellites of Saturn and Jupiter to have, as Sir ISAAC ſays, Pa. 238.

I imagine that I have great, if not ſufficient, Reaſons to believe that the whole Cauſe of the greateſt Tides being always at or about the Equinoxes, is abſolutely and entirely owing to the Nearneſs of the Luminaries to the Earth at ſuch Times; and Sir ISAAC NEWTON himſelf ſays, Pa. 257, That when the Luminaries are leaſt diſtant from the Earth, their Effects are greateſt on the Sea; which ſeems extremely reaſonable, and of which I make no doubt from the Nature of Attraction: But, if ſo, I would aſk a Newtonian, why the Tides are not greateſt in Winter? For 'tis allowed, by our Aſtronomy; that the Sun is almoſt Three Millions of Miles nearer then than in Summer, tho' no Difference is diſcovered in the Tides.

This profoundly-learned Gentleman juſt afterwards endeavours to attribute ſome of the Cauſe to the Luminaries Diſtance from the Equator; for doubtleſs he foreſaw that he ſhould otherwiſe be ſurrounded in an inextricable Dilemma: But whether this is ſtrictly mathematical or not, is a Queſtion. I think his Figure alone for the Explanation of the Tides (Pl. 10. Fig. 2.) makes one prejudiced againſt the Demonſtration, and gives a Footing to ſuſpect the Truth of it, being ſo diſtorted (as it were) and unnatural. But what could not ſo learned, ſo indefatigable, and ſagacious a Perſon do? Do! almoſt demonſtrate that to be Truth which in Reality is Falſhood!

Some of our late Aſtronomers pretend to demonſtrate, that the Moon's Path, or Orbit, is always throughout a whole Lunation Concave towards the Sun; and Mr. ROWE ſays, in his Fluxions, Pa. 161, thus, viz. Conſequently the Curve, generated by the Center of the Moon, has not a Point of contrary Flexure, or is no where convex towards the Sun; which almoſt amazes me; for the Earth herſelf cannot deſcribe ſuch a Figure, becauſe when the Moon interpoſes directly between the Sun and the Earth, the latter is attracted conſiderably towards the Sun and Moon, and will admit at that Time of a Tangent's being drawn within the Orbit, as is evident by the Nature of Curves of Retrogreſſion and Inflection. And if it is thus with the Earth, certainly the Moon's Path muſt be very waving and much more irregular than the Earth's, becauſe ſhe is ſometimes of one Side and ſometimes of another Side the Earth, with reſpect to the Sun. And what is very remarkable, a late Publiſher of Aſtronomy aſſerts the univerſal Concavity of the Moon's Orbit in one Place, and contradicts it in another. But, to ſet this Matter right, if I can, and becauſe I do not claim the Demonſtration myſelf, and am the greateſt Enemy to Plagiary, I refer the Reader to GRAVESANDE's Philoſophy, Vol. II. Pl. 24. and Fig. 4. explained in Pa. 242; which will be both full and clear, that the Moon's Path will be very waving and irregular, convex and concave alternately; and, to ſave Trouble to my Reader, I have borrowed the Figure which is placed for Fig. 4. in Pl. V. and the Explanation runs thus, viz. Let the Sun be at S, and the common Centre of Gravity of the Moon Q, and of the Earth M, at the Time of the Full Moon be at F: After one whole Lunation, that is, the next Full Moon, let the Centre be at A; and let F D A be the Orbit which we call that of the Earth; but in which it is the Centre of Gravity above-mentioned that does really move.

If this Lunation be divided into four equal Parts, after the firſt the Centre of Gravity will be at E, the Moon at P, and the Earth at L; after the ſecond Part of the Time, at New Moon, the Centre of Gravity will be at D, the Moon at R, and the Earth at I; in the following Quadrature the Centre of Gravity will be at B, the Moon at O, and the Earth at H; laſtly, at Full-Moon the Centre of Gravity being at A, the Moon will be at N, and the Earth at G; all which follow from the Revolution of the Earth and Moon about their common Centre of Gravity, whilſt it is carried in the Orbit about the Sun.

Therefore we ſee the Earth move in the Curve M L I H G, which is twice inflected in each Lunation; which Curve alſo does not return into itſelf, becauſe the Inflections in the ſeveral Revolutions, and a third Part of another, are perform'd every Year.

And Mr. KEILL, Pa. 182, clearly ſhews that Jupiter keeps in the Middle of the Orbits of all his four Attendants; and all allow that each of theſe Satellites performs its Courſe, in all Reſpects, the ſame as our Moon does revolve about the Earth. See his Plate XV. Fig. 3. which, I preſume, is fully convincing; but leaſt it ſhould not, I ſay thus, viz.

late

The Path of the Moon, as theſe Writers would have it, is ſo forced, and ſo unnatural, that it gives Offence at firſt Sight; for when the Moon is what we call New, and between us and the Sun, and conſequently then neareſt to him, ſhe is ſuppoſed by thoſe Gentlemen to ſtart backwards as it were all of a ſudden (as it plainly appears by their Figure), † and form an acute angular Point; but what Force or Power can or ſhould produce ſuch an irregular Motion, I know not; nor can they tell me, I preſume. When the Moon is at full, and furtheſt from the Sun, one ſhould think, that, much after the ſame Manner, in its returning ſhe would form another-like angular Point; but this is contrary to their Aſſertion, and both contradict the Truth, I preſume.

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† Vide, The Complete Dictionary of Arts and Sciences, Pl. 195, Fig. 2.

The Author, or Editor, I don't know which, of a late Publication, ſtyled Mathematics, endeavours to demonſtrate, that the Moon's Path will always be concave towards the Sun; but borrowed it I ſuppoſe from MACLAURIN; and Mr. NEALE has laboriouſly contrived a Machine to repreſent the unnatural Imagination of MACLAURIN and others; and this Author, or Editor, ſuppoſes two concentric Semi-Circles, the greateſt to roll on an Arch of a great Circle, and has theſe Words in a Scholium, Pa. 77. viz. That the Curve, deſcribed by the Centre of the Moon in one Lunation, is no where convex towards the Sun. But I would fain aſk the Editor this Queſtion, viz. Whether or no the Orbits of Jupiter's Satellites are not every periodical Revolution convex towards the Sun? His Anſwer, I ſtrongly imagine, ſhould abundantly convince him, without giving myſelf any Trouble. See p. 99.

But let us ſuppoſe the Author to be right in the Problem, from whence this Scholium is pretended to be drawn, the Nature of the Deſcription does not at all reſemble the Earth's and Moon's Orbits; for the inner Curve is always on one Side the Arch, and not between it and the Place where the Sun is ſuppoſed to be ſeated; but we know the Moon interpoſes between the Earth's Orbit and the Sun every Lunation, as the New Moon demonſtrates, conſequently the Caſes are not any way ſimilar.

I am at preſent ſomewhat doubtful whether the Problem itſelf is right or not; for it is manifeſt that if a Point be taken ſomewhere within a Semi-Circle rolling on a ſtrait or horizontal Line, that the Curve deſcribed by this Point will have a Point of Inflexion; and I don't know but I was the firſt Perſon that diſcovered this Property. Vide Ladie's Diary for the Year 1747, Pa. 21. Now, if the Curve which is the Baſe be deſcribed with a very large Radius, and the generating Circle is but ſmall in Proportion, I preſume the Curve deſcribed by a Point within the Semi-Circle will have ſome Convexity. But this latter Part being rather a Digreſſion, I ſhall at preſent ſay no more concerning it.

As there is another Problem in this ſame Treatiſe to find a new Sea Chart, the which is accounted an Improvement in Navigation, I hope the Reader will pardon me if I make a few Animadverſions on it, as it is a Matter of Conſequence, and very worthy of Remark.

This Author aſſerts, that all Meridians, Parallels of Latitude, and Rhumbs, are as truly and geometrically projected in ſtrait Lines on the Concavity of a Cylinder, whoſe Diameter is equal to the Axis of an incloſed Globe, as on the very Globe itſelf; which I think is quite impoſſible. For if ſuch Meridian Lines on a Cylinder's Side be infinitely continued, they will never meet, being parallel to one another: But we know that all real Meridian Lines do actually interſect one another in the Poles of the World: But any two Meridians in this Projection would be as far diſtant from one another at the Poles as at the Equator; which is manifeſtly abſurd. This Author remarks, that Mr. WRIGHT and MERCATOR, the Inventors of what is called Mercator's Chart, did not pretend to ſay that the Projection is a true one, but only an Extenſion of the Spherical Surface: And the Reaſon doubtleſs was, becauſe they both very well knew the Impoſſibility of it; and I imagine a little Reflection will convince the Editor that it cannot be. Mr. WRIGHT's Words are, "A more general Chart cannot be contrived in Plano, except a true Projection of the Sphere itſelf." When the Circle is ſquared (but not before) ſhould ſuch a bold Attempt be made.

It certainly is impoſſible that either of theſe Charts can be exactly true; and as far as I have examined them, ſometimes one, and ſometimes the other, comes neareſt the Truth.

No Chart thus drawn can fit a Globe, as is obvious, i. e. touch it ſmoothly when lain down thereon, without diſturbing the Situation of Rhumbs, Meridians, or Parallels, and without breaking or ruffling the Paper, and therefore it cannot be an accurate Projection. Further, if a Semi-Globe was to have Paper laid over it, and ſo join'd together as it may ſmoothly touch the whole Superficies, but capable of being taken off; I would aſk, whether this Paper when remov'd could be laid down ſmoothly on a Plane without breaking the Paper, &c.? We know it cannot; but was it cut from the Circle to the Circumference, in many Places it would touch all the Plane Superficies; but then there would be many Openings which could have no Lines at all upon them, therefore imperfect. It is poſſible to wrap Paper about a Cylinder, Cone, &c. whereon, if any Number of Points are made, the Bearings, Diſtances, &c. will be exactly the ſame when the Paper is taken off, and laid down on a Plane Superficies, as on theſe Bodies themſelves: But theſe Things are impoſſible on the Globe.

That the Rhumbs will actually be ſtrait Lines, as this Author ſays, is moſt manifeſtly falſe; for a Rhumb Line continued will be a truly-ſpiral Line, and at laſt fall nearly into the Pole of the World, as all thoſe who have written on Loxodromics have clearly demonſtrated; conſequently this Line cannot in any way poſſibly be a right Line, as evidently appears from ROBERTON's Navigation, V. 2. Prop. 10.

N. B. The Meridian Line in MERCATOR's Chart is a Scale of Logarithmic Tangents (omitting the Index) of the Half Complements of Latitude, to the Arches which they belong, as Mr.

HALLEY has demonſtrated; and the Meridional Parts themſelves may be very eaſily found, by the artificial Tangents, only by one ſhort Diviſion, as I have often experienced, and as eaſy as we can find the Hyperbolical Logarithm from the Tabular. The beſt and moſt elegant Account that I know of concerning theſe Meridional Parts, is in EMERSON's Fluxions, Pa. 115; and much better done than by STONE or SYMPSON, I think.

When I work by MERCATOR's Chart, I never trouble myſelf about the different Caſes, as is uſual; only remember that the Diſtance ſailed is dependent on the proper Difference of Latitude; and the Difference of Longitude on the Meridional Difference of Latitude.

It muſt be obſerved, that the natural Tangents are not in any ſettled Ratio to the artificial ones, from whence MERCATOR's Meridional Parts are found; thereſore they cannot be both true Charts: But MERCATOR's has been found, by long Experience, to anſwer the End propoſed in all Latitudes; and ſome prefer it to the Globe itſelf; but that muſt be on account of its Simplicity only.

One Thing more I would obſerve, which is, that I cannot ſee the Juſtneſs or Congruity of one Expreſſion Mr. WEST makes uſe of, viz. That Meridians are all parallel to the Axis of the World. I imagine that they are all coincident with it, and the Axis is in the Middle of the Plane of every Meridian, and biſects it.

The Moon's Motion appears extremely irregular to us here in *England*, much more ſo than at the Equator. But here her Meridian Altitude is various both in Summer and Winter. At the Time of Full Moon in Summer her Meridian Altitude is loweſt, and in Winter is higheſt, altho' at the Times of the New Moons ſhe is beheld to have the ſame Meridian Altitude as the Sun; and ſhe is continually varying every Lunation. And Leadbetter owns, that to compleat the Theory of the Moon it requires no leſs than 194400 Obſervations.

Why the Moon's meridian Altitude is ſo very low in Summer, and ſo high in Winter, at the Time of full Moon, appears very eaſy and extremely evident from my Hypotheſis; but it does not by the preſent received one, but the contrary. For which Reaſon ſhe ſeems to me to be a very unfit Object to determine the Longitude of Places by at Sea, which many attempt to do, by obſerving her Appulſes to the fixed Stars, tho' I imagine it cannot be attended with much Succeſs.

The frequent Abſence of the Moon by Night is likewiſe a very great Objection againſt the Fitneſs of it; becauſe, for a conſiderable Time after a new Moon, and the like Space in the laſt Quarter, the Moon is nearly with the Sun.

Indeed it is poſſible to find the true Place of the Moon at any Time; but it is a tedious Calculation, as every Aſtronomer muſt allow, who hath accurately gone thro' it. The finding of the Longitude at Sea by ſome ſure and eaſy Method, will certainly be a great and advantageous Diſcovery, and worthy the Study of the beſt and profoundeſt Mathematicians. But, I imagine, it ſhould be obtained by the moſt eaſy and ſimple Method poſſible, and ſhould not be attended with long and tedious Aſtronomical Calculatiohs; for we cannot ſuppoſe all Navigators to be good Aſtronomers; and if they were, they certainly have Buſineſs enough orherwiſe.

I have obſerved in ſome Books, that there was invented, by Mr. Stephen Gray, an Inſtrument by which the exact Time of the Night might be known, and a true Meridian Line drawn; the which, if it can be practiſed at Sea with Certainty, I may venture to ſay, that Longitude may be diſcovered within a Degree by the fixed Stars at almoſt any Place, except near the Poles; and that may be in ſome Meaſure excuſed, as Navigators have ſeldom much Buſineſs there. The nearer the Equator, the more exact the Determination will be; which I humbly imagine might hereafter be done in a few Minutes; eſpecially if the Manner of the Motion of our Earth was truely and accurately known. But, preparatory hereunto, there muſt be ſome new Tables made, which will not be difficult to do.

I have heard that ſome of our Great Aſtronomers laugh at an Attempt to diſcover Longitude by the fixed Stars; but I make no doubt but that they will be convinced of the contrary in a ſhort Time. For it is evident by Problem 13th, in ROBERTSON's Navigation, Vol. 2, that the true Time of the Night may be found by the Altitude even of one Star, as Arcturus, or any other, by having its right Aſcenſion and Declination, and alſo the Latitude of the Place, and the Sun's Declination; which may be always known.

My Method of diſcovering Longitude by the fixed Stars is already laid before a proper Body of learned Gentlemen for Examination; the Subſtance of which is nearly thus. —

The Attempt of diſcovering Longitude by the Appulſes of the Moon to the fixed Stars, lately practiſed in a Voyage intended for ſome Diſcovery, tho' none was made, is not only very uncertain, but is likewiſe too troubleſome and difficult: For, to compleat the Theory of our Earth's Satellite, it is own'd by LEADBETTER, that there are required no leſs than 194400 Obſervations to be made. I acknowledge the Moon's true Place is nearly to be found at all Times on the preſent Theory, tho' not preciſely; but it is a tedious Calculation, as every Aſtronomer muſt allow who hath accurately gone wholly thro' it.

The Moon's Abſence by Night is a very great Objection againſt the Fitneſs of it for the wiſh'd-for Diſcovery; becauſe, for a conſiderable Time after a New Moon, and the like Space in the laſt Quarter, the Moon is nearly with the Sun, conſequently not to be ſeen much by Night: But, beſides, her Irregularities are ſo many and ſo great, that ſhe ſeems to me to be the moſt unfit Object that can poſſibly be choſen for the Purpoſe; for an infinite Number of Obſervations made here in England would not be ſufficient to build on for a true Theory, as I can eaſily demonſtrate.

As to a Time-piece, notwithſtanding it is ſo highly improved by the ingenious and indefatigable Mr. HARRISON, I ſtrongly preſume it is not reaſonable to think that it will ever be brought to ſuch Perfection as to ſerve a long Voyage, where a Ship is continually changing her Latitude, and paſſing thro' different Degrees of Heat and Cold, Rain, Froſt, Snow, &c. let the Nature and Conſtruction of the Machine be what it will. Beſides, it does not ſeem to be the Thing the World is ſo deſirous of. Many Objections appear at firſt Sight; for every little Ship muſt be at the Expence of this Time-piece; and there needs great Care to keep it from Injury, and an Accident may ſpoil the whole; and we find many Misfortunes are frequently met with at Sea. But further, none perhaps but the Inventors can, and will, execute the Workmanſhip with that Care and Exactneſs there is required for ſuch a curious Piece of Work; and the leaſt Error, Omiſſion, or Slight, in the Execution, whether in Materials or Labour, will quickly render it unfit for keeping an invariable Account of Time.

As to JUPITER's Satellites, they muſt be acknowledged to be unfit to make this uſeful and univerſal Diſcovery, becauſe the Eclipſes happen ſo ſeldom; beſides the Uncertainty at what Time they will happen; which muſt cauſe much Trouble to wait, &c. Whence I conclude, that, in order to have ſome Probability of Succeſs, we ſhould fix on ſuch Things or Objects as are invariable, if poſſible. Thoſe which come neareſt to this Deſcription, I imagine, are the fixed Stars, which are innumerable, and always viſible in clear Nights, and very often by Day.

Now, it is not neceſſary (in order to diſcover the Longitude) to take Notice of many of the fixed Stars, but only ſuch as are remarkable, and thoſe which are pretty near the Equinoctial, if poſſible; becauſe of the Largeneſs of the Degrees there. When a certain Number of proper Stars for that Purpoſe are ſelected, let the Times when they will be on the Meridian of London, for every Day in the Year, be accurately calculated for; and this one Calculation will be ſufficient for a vaſt Number of Years, allowing fifty Seconds a Year for the Preceſſion of the Equinoxes.

Now, if it can be determined when, i. e. at what preciſe Time, any of thoſe choſen Stars will be on the Meridian which reſpects the Station of the Ship, by knowing the exact Time of the Night at that Place (which muſt be allowed may be known) I ſtrongly preſume it is ſufficient to find the Longitude deſired.

I have ſome Reaſon to think that the Time found by the fixed Stars will be more accurate than when found by the Sun; and my Reaſons will hereafter appear, when I ſhall propoſe and explain my new Syſtem.

Now, in order to obtain the Longitude required, I ſhould firſt make choice of one of theſe fixed Stars, and ſo near the Meridian and Equinoctial as convenient, &c. I ſhould next obſerve whether it is aſcending or deſcending, which is eaſily found in a ſhort Time; and when this is known, I would take the choſen Star's Altitude (allowing for Refraction); at which Time another Perſon might be employ'd in taking the Latitude.

The Star's Declination and right Aſcenſion are always both accurately known, and Tables thereof calculated for the Purpoſe already: We alſo know the Sun's eſtimate Longitude, right Aſcenſion, and Declination.

It is alſo manifeſt that when any one of theſe Stars hath ſuch an Altitude as correſponds with the Height of the Equinoctial and the Star's Declination, being either added to, or ſubſtracted from it, that then the Star will be on the Meridian: And to know the exact Time of Night when any Star will be on the Meridian which reſpects the Place, is ſhewn very clearly and eaſily in ROBERTSON's Navigation, Problem 13th, Vol. 2. So far the Way is clear.

Now, in order to procure a Demonſtration, I ſhall ſuppoſe the whole Company of the fixed Stars to revolve about the Earth once in a Year, as they appear to us to do, which is almoſt 1° p^{r}. Day (and which is equal to about 4' in Time) and apparently to revolve in ſuch a Manner as that the fixed Stars do come more to the Weſtward ſo much every Day; i. e. If a fixed Star is on the Meridian at one Midnight, &c. at any Place, the next following, the Star will be on the Meridian 4' ſooner, or 56' after 11, as we find it by Obſervation univerſally, and is occaſioned by the Earth's progreſſive Motion in her Orbit, ſhe making an entire Revolution Eaſtward about her Axis in 23^{H}. 5'6 4''; from which regular Motion, I ſtrongly imagine it w^{i}ll not be difficult to know the Difference of any Meridian from London. And if any Gentleman is not ſatisfied with what I have ſaid, I ſhould be glad to have his ſtrongeſt Objections ſent me to be anſwered. And if I ſhould fail in the Attempt, it is no more than far greater Men than I have done, therefore I humbly beg the Laugh may not be too ſonorous.

Now, as it cannot be denyed but that we can tell at any one Time in London when any particular Star will be on its reſpective Meridian, why cannot we tell at the ſame Time when this Star will be on the Meridian at any aſſigned Place whatſoever, as 10°, 20°, 30°, either &c. Eaſt or Weſt from London? Doubtleſs we can. Then, if ſo, it is extremely manifeſt that it is only the Reverſe of this Operation, to find the Difference of Meridians, or Degrees of Longitude from London to the Ship's Station. As for Inſtance; —

Let us ſuppoſe the Star Arcturus was on the Meridian of London, as in the Example already mentioned in ROBERTSON, viz. at 9^{H} 50' the 27th Day of November at Night, in the Year 1752, and that its Altitude at London was then 27° 12', at 3' after 5^{H}, P. M. Now, let us ſuppoſe that a Ship was ſo far to the Eaſtward of London as that this ſame Star ſhould be preciſely on the Ship's Meridian at the Time of Obſervation at London (which was 5^{H} 3'); it is obvious we can find the Time when this Appearance happened; and for the Sake of Brevity, &c. we will ſuppoſe the Ship in the ſame Latitude 51° 32'.

Now we know that this Star will be on the Meridian of London at 9^{H} 50' P. M. that Night, &c. which is the Hour or Time of Night then where the Ship is; to find which, there needs no more be done than to ſubſtract the Star's Right-Aſcenſion from the Sun's ditto, thus 16^{H} 13^{m} — 14^{H} 3' — 2^{H} 10', which ſubducted from 12^{H}, leaves 9^{H} 50', the Time required; from which take the Time at London 5^{H} 3', there remains 4^{H} 47', which is the Difference of Longitude.

Next let us ſuppoſe this Ship ſome other where, ſo as this Star's Altitude at the ſame Time, as at firſt, be 40°, &c. then by ſtereographically projecting the Sphere, and by the 11th Caſe of oblique-angled Spheric Trigonomitry you may find the Hour from Noon, and conſequently the Difference of Longitude required, becauſe we ſhall know how long it will be before the Star is on the Meridian.

To have a ſatisfactory and fair Trial for Mr. HARRISON's Machine, I preſume there ſhould be three or four of ſuch Automata carried in one Ship, and under the Care of ſo many different Perſons, and compared together once every Day to ſee their Agreement, &c. And I believe if an Experiment was made from Greenland to Cape Horn, &c. the Longitude would be very badly aſcertained. But in my Method, no Alteration or Difference could ariſe, by any Inclemency of Weather or any Diſtance whatſoever, beſides the Advantage of its being attended with no Expence.

Perhaps it may be thought by ſome that I have ſaid too much concerning a Secondary Planet; but when it is conſidered that the Moon's Path is the moſt difficult to be traced of any Planet whatſoever, I hope I ſhall not be thought culpable, becauſe her Irregularities, as our Aſtronomers call them, are ſo many, ſo great, and ſo different; and I do not ſcruple to ſay that her true Motion is not yet known; for the Proof of which Aſſertion I ſhall at preſent only make this one Obſervation, it being ſufficient, viz. That in the Solar Eclipſe which happened July the 14th, 1748, the Digits which were eclipſed appeared but little more than Eight, to the Surprize of every curious Beholder: But all our Aſtronomers, tho' the Calculations were made from divers Tables, nearly agreed that the Digits eclipſed were about Ten and Half. GEORGE SMITH, Eſq; in his Sheet which was publiſhed thereof, made the Digits eclipſed at London 10 ¾: Whence it muſt evidently appear that the Moon's Path is not truely known: And this is ſuch an undeniable Fact, and was ſo great an Error, that I wonder no Aſtronomer ſince has endeavoured to inveſtigate the Cauſe of this wrong Calculation, and have ſought for a Remedy that no ſuch Blunder might evermore appear to the World.

CHAP.

CHAPTER VI.

Of the ſuppoſed Univerſal Law for the regulating the periodic Revolutions of the Planets by knowing their Diſtances from the Center of their Orbits; and the contrary.

ASTRONOMERS now agree that all the Planets in their Circulations, whether Primary or Secondary, obſerve this immutable and univerſal Law, viz. That the Squares of their periodic Times are invariably as the Cubes of their Diſtances from the Center of their Orbits; but I imagine there is not any ſufficient Proof for the Aſſertion. The bare Thoughts of imagining that an infinite and omnipotent Creator ſhould think of working by mathematical Rules, as by Squares, Cubes, &c. is ſomething ſo mean and derogatory from Divine Wiſdom, that I am ſurprized a true Philoſopher ſhould make ſuch a daring (or rather mean) Aſſertion. For if the Almighty was only to ſay (if I may ſo ſpeak) do This, or That, it muſt of Neceſſity be immediately performed; and Inſtances hereafter will be ſhewn in a proper Place. But theſe two Things might here be mentioned, viz. That at our Saviour's Crucifixion, the whole Earth was involved in a long and unexampled Darkneſs, without any natural Cauſe whatſoever: And at his Nativity a new Light or Star appeared with ſuch Motion as no other Star or Planet has, and ſhone very reſplendent.

They have given indeed the Primaries ſuch imaginary Diſtances, but they ſeem incredible to me; and I ſhall in Chapter the 9th ſhew a truely mathematical Method to find the real Diſtances of the Sun and all the Planets, independent of any Hypotheſis whatſoever; and when proper Experiments are made, I ſtrongly imagine that the real Diſtances will widely differ from the preſent imaginary ones.

The juſtly celebrated Mr. KEILL ſays, P. 34, That Sir ISAAC has demonſtrated, that, without a total Subverſion of the Laws of Nature, no other Rule, than the above could take place in the Circulation of the Heavenly Bodies. But to aſſert that the Almighty is always obliged to follow, or execute, one limited Rule, ſeems to be a circumſcribing Eternal Omnipotence. Nature certainly diſdains ſuch dull Uniformity; and, on the contrary, ſhe delights in boundleſs and infinite Variety.

By knowing the periodic Time of our Earth's Revolution, and accounting our Diſtance from the Sun to be 81 Millions of Miles, and alſo by knowing the other Planet's Periods, 'tis eaſy from the above Rule to find their Diſtance on ſuch a Baſis: But if we are miſtaken in the Diſtance of the Sun, as I think we are to a ſurprizing Degree, all the reſt fail of Courſe.

To think that Saturn ſhould be 777 Millions of Miles diſtant from the Sun, and we about 700 Millions from this Earth-like or opake Body, and that a naked Eye ſhould be able to diſcern him ſo clearly here, is not a little ſtrange. The Light and Heat which fall on this Planet muſt be extremely weak when received, he being about Ten times further from the Sun than we are, and for the ſame to be reflected back to us appears ſtrange indeed. For we cannot diſcover a Candle in a dark Night perhaps above two Miles with the naked Eye; and I ſincerely believe that if Saturn was at that immenſe Diſtance imagined, no Perſon on this Earth would have ever beheld him.

Let us now ſuppoſe the Diſtances of all the Planets to be as our Aſtronomers ſay: Then if this Law of which we are ſpeaking is univerſal throughout our Syſtem, nay if it is not, it is no Law at all; from having the Diſtance of any Secondary from the

Center of the Orbit and the periodic Time of the Satellite, and alſo having the Diſtance of another Primary's Secondary, this Rule ought to find the periodic Time of this Satellite, if the Rule is general, as is ſuppoſed. Now, let us ſuppoſe Jupiter's innermoſt Satelite to be about 230000 Miles from Jupiter's Centre, as Aſtronomers nearly make it, and Saturn's innermoſt Moon to be about 187000 Miles diſtant, by the foregoing Rule, Saturn's Moon ought to compleat the periodic Time in much leſs Time than Jupiter's Moon does. But this is contrary to all Obſervations: And if we were to apply this Rule to our Moon from theſe Secondaries, and make her Diſtance from the Earth to be about 240000 Miles, her periodic Time would be about two Days inſtead of a Month, as we really find it.

I ſuppoſe that if Venus had a Satellite, as ſome Aſtonomers imagine, and juſt as far off from it as our Moon is from the Earth, and perhaps of the ſame Magnitude, that it might finiſh or travel round its Orbit, either in more or leſs Time than our Moon does, and yet this univerſal Rule remain unviolated. Amazing! And from the Teſtimonies of Mr. MONTAIGN, M. J. D. CASSINI, Mr. BAUDOUIN, and Mr. SHORT, we muſt believe Venus has an Attendant; but the Cauſe, or Reaſon, why it is ſo ſeldom ſeen is not yet to be accounted for; for Mr. SHORT could never ſee it ſince the firſt Time, tho' he has earneſtly and frequently ſought for it: And Mr. MONTAIGN thinks this Satellite might revolve about Venus in the Space of Twelve Days, tho' our Moon takes Twenty-Eight for her Revolution, and our Earth is ſuppoſed to be nearly of equal Magnitude with Venus. Hence I preſume it is manifeſt, that inſtead of a general Law thro' the Planetary Syſtem, every Primary has a peculiar Law to itſelf, notwithſtanding the much-boaſted Harmony our Aſtronomers ſo often mention. That Jupiter's firſt Satellite ſhould run in 42 Hours almoſt 15 Hundred Thouſand Miles, and our Moon only one Hundred Thouſand in the ſame Time, is pretty remarkable.

I am ſomewhat puzzled to reconcile Sir ISAAC with Mr. KEILL. The incomparable NEWTON, ſays, Phœnomenon IV. P. 210, That the Fixed Stars being at Reſt, the periodic Times of the five Primary Planets (and whether of the Sun about the Earth, or of the Earth about the Sun) are in the ſeſquiplicate Proportion of their mean Diſtances from the Sun: But the excellent Dr. KEILL ſays, P. 34, "That this Rule will give the Sun's Diſtance but 340 Semi-Diameters of the Earth, whereas Aſtronomers aſſert, that the Sun is above 30 Times farther from us, at which Diſtance he would be 54700 Years in revolving about his Orbit." But was the Sun at this Diſtance, and to revolve about the Earth, our Aſtronomy will not determine the exact periodic Time; for the Moon is nearly the ſame Diſtance from the Earth as the neareſt of Jupiter's Satellites is to him; yet the latter runs ſo much in about 42 Hours as the former does in a whole Month. I make the Sun's mean Diſtance about 360 Semi-Diameters of the Earth.

I freely confeſs that I do not underſtand how this univerſal Law would prevail, if the Sun was to move about the Earth inſtead of the contrary. For, was the Earth placed in the Center, and the Sun to revolve about her 81 Millions of Miles diſtant, ſometimes the Sun would be 162 Millions of Miles nearer a Planet than at another Time, which would certainly cauſe many and amazing Irregularities, and deſtroy the Frame and Beauty of our Solar Syſtem, if I underſtand Sir ISAAC aright. There may be ſome Ambiguity in the Expreſſion, for what I know; and if I miſinterpret the Words I am ſorry for it; and alſo if I am miſtaken, I beg the Reader's Pardon; which I hope will be granted, becauſe I am ſincerely enquiring for the Truth, which I hope this Treatiſe will be the Occaſion of diſcovering whether I my ſelf be the Diſcoverer or not.

CHAP.

CHAPTER VII.

Of the Eaſt and Weſt Points.

ALTHO' theſe Points are ſeemingly well enough known by the moſt Vulgar, yet, if we enquire nicely into the Matter, we ſhall find that the Learned diſagree much concerning them; and if our Earth has ſuch a Motion as is imagined, I believe it is impoſſible to determine the Matter accurately, or mathematically, let the fixed Stars be at any Diſtance whatſoever; for altho' they appear equally diſtant from us, perhaps there may not be two Stars preciſely ſo. Some which appear may be double or triple the Diſtance that others are.

ILLUSTRATION.

LET E W, Fig. 5, repreſent the Equinoctial, and A C the Ecliptic: Now, when the Earth is at B, the Star at S or s will doubtleſs be due Eaſt; but if the Earth is at A, the Star R or r will then be the due Eaſt Point in the Heavens, if our Earth's Axis preſerve a Paralleliſm, as is allowed: And when the Earth is at C, then the Star T or t will be the true Eaſt Point; and the Diſtance from R to T is not leſs than 65 Millions of Miles, i. e. on Suppoſition that our preſent received Hypotheſis is the true one: But our Aſtronomers think, at preſent, that this great Diſtance will cauſe no Difference. But I believe they will hereafter find themſelves vaſtly miſtaken: For the ſame Star that is due Eaſt in Summer cannot poſſibly be ſo in Winter; for if the parallel Lines, A R and C T be infinitely continued, they muſt ſtill retain their primitive Diſtance. But we never can diſcover any Difference in the ſame Stars Eaſting or Weſting in Summer or Winter, as there actually would be did our Earth move as is imagined.

gined. By my imaginary Syſtem the Eaſt and Weſt Points will be unalterable, and always in the Plane of the Equinoctial without any Deviation.

In GRAVESANDE's Philoſophy, Def^n. 7, P. 187, 'tis ſaid, « That the Eaſt Point is that in which a Line directed Eaſtwards perpendicular to the Meridan Line, and going thro' the Obſerver, cuts the Sphere of the Fixed Stars;" whence it follows, if an Obſerver is but a ſmall Diſtance from either Pole, a Line perpendicular to the Meridian may then have an Eaſt Point; but it will not be at the ſame Place as a Perpendicular would point to, if it ſhould paſs thro' an Obſerver at the Equator: And one MeridianLine may be perpendicular to anotherMeridian Line at the Poles, which ſhould be Eaſtward by the Definition: But all Geographers I think agree, that a Perſon at one of the Poles can look no Way but towards the other.

It is aſſerted by moſt good Writers on this Matter, that of two Places, not at the Equator, as, for Inſtance, *Briſtol* and *London*, that if the former ſhould be due Weſt from *London*, that *London* will not be due Eaſt from *Briſtol:* But Mr. SALMON, in his Geographical Grammar, P. 18, ſays, that the Arguments made uſe of to prove it are ungeometrical.

I ſhall not at preſent undertake to determine who is right in this abſtruſe Matter; neither do I know of any Author that has examined it nice enough to amount to any tolerable Demonſtration; for we may ſee ſome Authors, who adhere to the former Opinion, diſagree in the Quantity of the Angle. And I think there are many Things concerning the Globe that are not yet ſatisfactorily explained, particularly the Loxodromic Line.

CHAP.

CHAPTER VIII.

Of Comets.

THAT Comets belong not to our Planetary Syſtem ſeems highly reaſonable to me: Becauſe if Bodies have ſuch extremes of Motion as theſe are ſuppoſed to have, it appears to me to be inconſiſtent with Eternal Wiſdom and Uniformity; and for theſe Irregularities to proceed from a regular, perfect, and all-wiſe Being, I preſume, cannot be reconcileable to Reaſon or Nature. For a Body to fly ſometimes with an incredible and amazing Velocity, and at another Time ſcarce to move, is ſomething ſo aukward, and ſo unnatural, that I cannot conceive how Aſtronomers could give their Aſſent to the Theory. And alſo, that a Body ſhould be ſometimes Two Thouſand Times hotter than red-hot Iron, and at other Times as cold as Ice or Snow, is ſo ununiform, ſo ſtrange, and ſo inconſiſtent, and the Continuance of each Extreme ſo long, that I think we may juſtly and reaſonably conclude, that no Beings, ſcarce of any Kind whatſoever, can inhabit there. Whence, theſe Bodies ſeems to be created in vain; but ſuch a Thing we cannot reaſonably ſuppoſe, becauſe the Product of an all-wiſe Being. We cannot diſcover that they are of any Uſe to any Part of this Solar Syſtem to which they wholly belong, according to our preſent Aſtronomy. But if they did belong to this Syſtem, they certainly would obſerve the ſame Laws, and move the ſame Way, as all the Planets do. But theſe Comets traverſe the whole Heavens every Way, as from Eaſt to Weſt, and the contrary from North to South, and South to North, &c. &c. and muſt violently break thro' all our Planets Orbits, cutting them divers Ways, both in approaching to, and receding from the Sun. And how it is that no Comet has ſtruck againſt our Earth in its Journey, or one of the other Planets yet, is to me ſomewhat ſtrange, if Comets Orbits are as imagined to be. If once a Comet ſhould arrive ſo near the Sun, as aſſerted, I cannot believe it would evermore fly off, but muſt fall into the Sun. Now, if Comets are ſometimes ſo near the Sun as Aſtronomers ſay, ſhould no curious Obſerver yet have ever diſcovered that they revolve about their Axis? For it is ſuppoſed they do like the other Planets. We can diſcover that Jupiter and the Sun both revolve about their Axis tho' ſo very diſtant from us: Then, ſince a Comet muſt ſometimes be much nearer to us than either of them, and that for a great part of the Time whilſt 'tis viſible, why ſhould we not be able to diſcover this Rotation?

But, further, as a Comet muſt be, in travelling over its Orbit, between the Earth and the Sun twice, and ſometimes within a few Degrees of the latter, how, or why, is it that no one Comet yet ever appeared either gibbous or falcated? They certainly would appear ſo beyond all Doubt, and as Venus and Mercury do, if they are opaque Bodies like them, as Aſtronomers allow.

Sir Isaac ſays, P. 327, That it is evident that all Comets in their Perihelions muſt either be placed below or not far above Saturn; which Expreſſion ſeems to make one doubtful whether Comets come within Saturn's Orbit or not, according to his own Opinion.

How contradictory the above is to his Trajectory, &c. concerning Comets, I ſhall leave the curious Reader to determine. Too inconſiſtent, one would think, for him who is ſtiled the moſt Excellent, Incomparable, Immortal, &c. and might I not add, Infallible?

Further; The introductory Lemma of Sir Isaac Newton concerning Comets runs thus, viz. — "That the Comets are higher than the Moon, and in the Regions of the Planets." On which I ſhall make the following

REMARKS.

REMARKS.

WHAT our great Law-maker means by *higher* than the Moon, I do not well underſtand; as to the Appellation *high* or *low*, with reſpect to our whole Planetary Syſtem, or the Univerſe, there can be no ſuch Places in Fact from us, nor otherwiſe than this, I think, viz. That if we allow the Sun to be in the Center of it, that Body which is furtheſt off from him may be called the higheſt in this Reſpect.

Now, if theſe Comets deſcend not lower than the Moon in this Senſe, and I know of no other, properly, then, it follows, they never can poſſibly ſurround the Sun, tho' ſtrenuouſly affirmed by our Aſtronomers. Hence this Lemma, which is deſigned to pave the Way for the Belief of the preſent Theory of Comets, directly oppoſes it: And Page 325 Sir ISAAC ſays, That the Comets often deſcend below the Orbs of Mars and the inferior Planets, and uſes the Word *often*, which ſeems to imply that they do not always come ſo low; and if not, how can the Sun be in the Focus of the Orbit?

Our Aſtronomers indeed talk of the higher and lower Apſides of a Planet's Orbit; but I wiſh they would conſider Nature better, and run not ſo widely aſtray as at preſent they do. I might with the ſame Propriety ſay, that we are higher than our Antipodes. But I believe a Naturaliſt would laugh at the Aſſertion.

And doubtleſs ſome will ſneer at Sir ISAAC's Expreſſion in P. 372, which is, That he ſuſpects that it is chiefly from the Comets that *Spirit* comes; which is indeed the ſmalleſt, but the moſt ſubtle und uſeful Part of our Air, and ſo much required to ſuſtain the Life of all Things with us. But the Waggiſh may perhaps ask, How is it that Life is ſo well ſuſtained at this Time, when we have had no remarkable Comet to pour out its Spirit upon us theſe many Scores of Years laſt paſt? But, to be more ſerious,

One Thing more before I leave Sir ISAAC. In his prodigious tedious Propoſition 41, Problem 21, he endeavours to determine the Orbit of a Comet moving in a Parabola from three Obſervations, juſt as if there was in Nature any ſuch Orbit for a Body to revolve in; and very ſeriouſly and learnedly diſcuſſes the Matter. But, in P. 377, he ſays, That from the Times of Comets Revolutions the tranſverſe Diameters of their Orbits will be given, and from thoſe Diameters the Elliptic Orbits themſelves will be determined. Here it is to be obſerved, that Sir ISAAC calls the Orbits elliptical, notwithſtanding all that went before. But how an Ellipſis can be a Parabola, or a Parabola an Ellipſis, I do not underſtand; for their Properties are very different. For an Ellipſis is formed by the Section of a Cone when the Plane paſſes through both Sides; but a Parabola is formed by a Plane paſſing through only one of the Sides of a Cone, as is well known, and therefore can form no Curve that will return into itſelf; conſequently there can be no ſuch Orbit.

What Age Sir ISAAC was when his Mathematical Principles of Natural Philoſophy uſhered themſelves into the World, I know not; but certainly many Aſſertions are quite incompatible, tho' not quite ſo contradictory as *Baxter* againſt *Baxter*.

But I ſhall now examine Sir ISAAC's Account of the Trajectory, &c. of the great Comet which appeared in 1680, and ſee how the Motions will agree with the Theory. See his Plate the 18 Explanation, &c. or my Fig. in 6. Pl. 1.

This Gentleman ſays, that the Path of this Comet did very much deviate from the Path of a great Circle, and aſſigns this Reaſon for it, viz. That it did cut the Ecliptic twice, and in the End of Virgo and Beginning of Capricorn, and not in oppoſite

Points of the Heavens, &c. But I openly confeſs that I cannot diſcern any Strength or Certainty in the Reaſoning in this preſent Caſe: And I ſincerely believe that this Reaſon would not paſs for a Demonſtration under any other Name than that of the immortal NEWTON.

For whether the Arch of the Ecliptic was 98° or 8° only, the Comet's Orbit might be a real Circle, notwithſtanding its Appearance to us otherwiſe, as I ſhall in this Chapter fully demonſtrate. And the Appellation Great Circle can have no different Meaning, I conceive, from a Circle; for we ſay, that the Moon apparently deſcribes a great Circle in the Heavens as well as Saturn, &c.

Further: If a Comet ſhould cut the Ecliptic in its Deſcent, in any certain Point, and in its Aſcent paſs over the very ſame Place again, and the whole Path ſhould appear to us as a Right Line, yet the real Tract or Orbit might be a Circle, if we are ſituated in the Plane of its Orbit continued, which deſerves ſome Notice.

Again: 'Tis allowed by all our modern Aſtronomers that a Comet will move ſwifteſt of all when in its Perihelion, (if it may be ſo called) and ſlower by Degrees as the Diſtances increaſe from the Sun. Now, we find by Sir ISAAC, that November the 20th, in this Comet's Approach to the Sun, that it apparently deſcribed an Arch of about 5° each Day: Then from November 26th to December 12th, during which Time it paſſed its Perihelion, it did not all this Time deſcribe 3° a Day; after which Time its Motion was accelerated, and it deſcrib'd again about 5° each Day as at firſt. Now, how theſe Obſervations can agree, or be reconciled, with the Theory of Comets, I own I am unable to explain: For when, by the Theory, the Comet ſhould move ſwifteſt, I imagine that it then moved ſloweſt; and the contrary.

Now, ſince I think the preſent Theory of Comets wrong, I will here venture to give my Thoughts concerning them; and if they ſhould not be agreeable to my Readers, I beg they will pardon me, becauſe every Perſon has an undoubted Right to think for himſelf; and it ſhould be without Offence, as it is done with a Deſign of not offending.

Now, firſt, I imagine that our Syſtem is not the only one in the Univerſe; but that there are a great Multitude, and of various Kinds; and I preſume they are ſeparated entirely from one another, ſo far diſtant as no Diſturbance or Confuſion may ariſe from their Vicinity to one another. Next, let us ſuppoſe ☉ to be our Sun, Fig. 1. P. 2. and the Circle E E to be the Earth's Orbit, and the unlettered Circle ~~K K~~ to be Saturn's and coincident: Then let us ſuppoſe A, B, C, D, E, to be Suns to other Syſtems, and F G H I, K L M N, O P Q R, S T V U, and W X Y Z, to be circular Orbits, and the utermoſt Planets of their reſpective Syſtems, and variouſly inclin'd to the Earth's Orbit, ſo as theſe Circles may appear as delineated in Plate the 2d, and the Appearances are not only poſſible but natural.

Now, let us imagine the Earth to be at E, and a Planet of another Syſtem at H, moving uniformly about A, then 'tis manifeſt we ſhall behold this Planet to move apparently faſter at H than I, becauſe at the latter Place it will appear almoſt ſtationary for a conſiderable Time; and when it is arrived at G, it will then appear to move with the ſame Velocity it did when at H. And this Kind of Orbit will account for and agree with the Motions of the Comet 1680, as deſcribed above, very nearly, if I miſtake not, and in an eaſy and accurate Manner. From whence it is evident, by the different Figures in this Plate, that a great Variety of Motions apparently different may ariſe from perfectly circular Orbits, according to their different Inclinations to the Earth's Orbit; and alſo from various Directions of different Bodies: for our Earth and one Comet may move nearly one Way ſometimes, and another Comet quite contrary to the Earth; from whence will ariſe numerous Kinds of Motions in theſe Bodies,

dies, tho' they may all travel circular Orbits. For in Fig. 4th, a Comet would almoſt appear to deſcribe a right Line perpendicularly; and in Fig. 3d, almoſt a right Line horizontally; but in the loweſt Part, as L M, it would deſcribe a much larger Arch in a Day than at N. Other Irregularities may be obſerved in Figures the 5th and 6th, as will appear by Inſpection only. But it may not be amiſs to obſerve, that if, in Fig. 5th, the Arch V U, neareſt the Sun, be made equal to the Arch T S, that a Comet will appear to deſcribe a much greater Arch when neareſt the Sun than when further, agreeable to the eſtabliſhed Theory of Comets: For we meaſure the Arches deſcribed by the Angles V F U and S E T agreeable to Optics; and we have no other Way of meaſuring them, tho' it affords not that Satisfaction we could wiſh for: And I think it quite impoſſible for the niceſt Obſervers ever to determine the exact Return of a Comet. For if a Comet ſhould in reality deſcribe any certain Number of Degrees of its Orbit in a certain Time, it may appear to us to have deſcribed double that Quantity, or otherwiſe but half thereof, &c. And I am not aſhamed to ſay, that I am ſurprized that ever any good Geometer ſhould ſeriouſly attempt it. I know it is ſaid, that Mr. HALLEY has obſerved that a remarkable Comet had appeared four Times at nearly equal Intervals of 575 Years; and this Gentleman has taken incredible Pains concerning it: But (to me) no ſatisfactory Demonſtration appears of the Certainty.

If my Notions are right concerning Comets, Saturn, in all Probability, once in thirty Years may appear as a Comet to ſome neighbouring Syſtem. And as to ſuch a one who has Satellites, theſe latter may be little or faint Comets ſometimes, and fly with great apparent Velocity. Nay, I will not ſay that they will not account for new Stars, as Aſtronomers name them.

As to the Nature, &c. of the Tails theſe Bodies emit, there are ſo many and ſuch various Reaſons aſſigned, that I know not which are the moſt reaſonable. ROWNING differs from Sir ISAAC; and others from both; and as it is, and muſt be, all Conjecture, I ſhall not ſay much concerning them. But as I imagine that every Comet we have ſeen has another Sun that heats it much more than our Sun does, I gueſs that all the Steam, Vapours, &c. which ariſe from this double Heat, muſt aſcend wholly, or be directed to its own Sun, becauſe of the ſtrongeſt Attraction; and this Steam, &c. I imagine, forms the Tail; whence we muſt behold it nearly oppoſite to our Sun, or rather in a direct Line to its own. Now if theſe Comets are ſituated as I have deſcribed, their vaſt Diſtances muſt unavoidably prevent us from diſcovering a Rotation about their Axis, as Saturn's does: And it alſo naturally gives the true and only Reaſon why they never appear either creſcent or gibbous.

'Tis well known that a great Comet was expected again by all our Aſtronomers in 1758; but as it did not return, as in 1682, why ſhould we ſtill inſiſt that our Theory of Comets is true? With what Reaſon can we do it? The niceſt Obſervations are not likely to determine the Path nor Period of a Comet; for we never ſhall have, nor could we wiſh for, better Opportunities, nor greater Men, to foretell the Return of one of theſe ſurpriſing Bodies; and therefore let us reſt ſatisfied with what little we know of them.

CHAPTER IX.

Of finding the true Diſtances of the Sun and Planets from the Earth ſtrictly Mathematically, and quite independent of any Hypotheſis whatſoever. And alſo of Refraction in the Heavenly Bodies.

SOME Readers, at firſt, may think that I have borrowed one of the following Hints, or ſomething like it, that is here uſed, from M. DE CAILLE, or from *St. James's Chronicle*; but I ſincerely declare, that I never ſaw any Thing like my Method until *June* 26, 1763, nor is this like it; and, altho' this Chapter was written long before, I have not altered or added one Word to it ſince. And that it is not any Kind of Plagiariſm muſt evidently appear to every ſtrict and capable Enquirer; and what will confirm it is, the Method that is inſeparably interwoven concerning a Method to obtain the Quantity of Refraction in the Heavenly Bodies; which Method, &c. I believe was never thought of by any other Perſon.

As the Method of finding the Sun's and Planets Diſtances by the Method of Parallaxes, &c. is, and muſt be acknowledged by every impartial Mathematician to be, very doubtful indeed, I ſhall here ſhew a truly Mathematical Method, and cannot be attended with ſuch Doubts as the former, and will be almoſt certain; from my uſing a Chord Line of the Earth.

Let there be three Aſtronomers placed under one Meridian, or as near as poſſible, one of them at the Equator, one in great South Latitude, and the other in equal North Latitude; for the greater the Latitude is, the more nice the Determination will be. Africa alone may poſſibly afford three Places, for what I know: But if we can find a Place in North Latitude, equal to that of

Cape Horn, &c. I preſume it will be more eligible: And if by Maps and Tables they ſhould be a little miſled in ſtationing themſelves, it cannot cauſe much Difference; but it will not be very difficult to rectify the Matter, by comparing Obſervations afterwards; for we are poſitive both Latitudes will be accurately determined, and if they ſhould differ ſomewhat, we can give juſt Allowances for the ſame. But if all three Perſons ſhould be ſtationed juſt under one Meridian, which is not very improbable, the Determination will be to a very great Nicety, I imagine; becauſe they will all behold the Object, as the Sun, Moon, or Planet, at the ſame Moment of Time; and there needs ſcarce any Obſervations to be taken but when the Star, &c. is on the Meridian, and then every Opportunity ſhould be embraced, and the Altitudes, Diameters, &c. taken, and regiſtered with the Day of the Month. And great Satisfaction would accrue from theſe three Perſons Obſervations in the Solar Eclipſe which will happen in April ~~March~~ 1764, becauſe they will have different Appearances; and, I imagine, greater Advantages would be gathered from this Phœnomenon than from the late Tranſit of Venus over the Sun; and if ſuch an Eclipſe had happened either in June or December, the Appearances to the Northern and Southern Obſervers would be much more different than in this, I preſume. And if, at this Time, there were two Aſtronomers more placed at the Equator, equally diſtant from the firſt, any certain Number of Degrees, as perhaps 30 or 40, they could know at what Time to obſerve any Planet, &c. the very ſame Moment the others do, when on their Meridian, which would ſtill contribute to Exactneſs and Diſcovery, both as to the Sun's Diſtance, and Quantity of Refraction.

ILLUSTRATION.

LET C repreſent the Center of the Earth, N the Northern Beholder, E the Equatoreal one, and R the Southern Obſerver:

See Fig: 1. pl. 3.

ſerver. Now, as we actually know the Dimenſions of our Earth, and alſo the Latitudes the Obſervers are in, we ſhall likewiſe know the real Diſtance between the two Obſervers N and R a Chord Line, by the Property of the Circle: And by drawing the Tangents R H and N H, which will be Horizons, we ſhall have the Angles C H N, &c. for the ∠ E C N is equal to the Latitude of the Place, and p$^{r.}$ ſimilar Triangles, the ∠ H R P = ∠ P C N, &c. Now if an Obſervation be taken when the Sun is at ☉, or really in the Equinoctial, which is not improbable, it is obvious that the Triangle N ☉ R will be Iſoceles, and the Calculation will then be the moſt ſimple imaginable: For the Angles of Altitude H N ☉ and H R ☉ will be preciſely known and equal; whence by having theſe Angles, all the Angles of the Triangle R ☉ N will be given, and the Side R N which is conſtant: Hence the Diſtance P ☉ will be found, and by ſubſtracting the verſed Sine P E from it you, will have E ☉, which is required.

If the Sun ſhould be at S, the Angles of Altitude will ſtill be known, as is evident by the Figure, tho' not equal to one another; and by having the both ∠^{s} of Altitude, viz. H N S and H R S, we may, by having the ∠^{s} before found, i. e. ∠ H R P = H N P, have the ∠ S R N and ∠ S N R, whence we may find the remaining ∠ N S R, it being the Complement to 180°. Hence we can find the Sides per Oblique Trigonometry.

It may be here obſerved, that the Perſon at R will not ſee the Sun where the Obſerver at N does, nor will either perceive him in the Equinoctial, but the one at r and the other at t, and not at h, where the Spectator at E would behold him. And in like manner when the Sun is at S, one Obſerver will ſee him at a, and the other at b: And if theſe Obſervers were to obſerve the Moon when really in the Plane of the Equinoctial, as at ☾, the middle Perſon indeed would ſee her at h, but the others at f and g, and not where they perceived the Sun when in the Equinoctial, tho' our Aſtronomers look over this momentous Affair lightly.

Perhaps it may ſeem ſuperfluous at firſt to have any Obſerver at the Equator; but I am poſitive that many Advantages will ariſe from the Obſervations there taken, by meaſuring the Diſtances from his Zenith, where there will be but little Refraction; which may be of ſingular Uſe in comparing Obſervations when the Work is finiſhed.

And, further, when the Sun and Moon are in the Equinoctial, I would have this Obſerver carefully take the exact Times of their Riſing and Setting; for the Time of their reſpective Stays above the Horizon will determine the Quantities of their Refraction; for what Time they then riſe or ſet before and after Six o'Clock will moſt accurately, as well as eaſily, determine the preciſe Refraction of theſe Bodies in a right Sphere, by reducing Time to Motion. But it is to be noted, that the Place of Obſervation ſhould not be in a Valley.

Let us next ſuppoſe the Moon, or any other Planet, to be at M, the Obſervers at R and N will not only have the Angles of Altitude as before, but will likewiſe have a moſt conſiderable Advantage: For the Artiſt at R will behold the Planet at d, and the other at N will ſee it at e, amongſt the Fixed Stars; and we know their Latitudes, Longitudes, and Diſtances, from one another, as well, if not better, than we do the Diſtances, Bearings, &c. from one City to another, even in Europe; whence the Angle d M e, or the Arch d, e will be known, and by the Methods before, we have the ∠ N M R, which will be preciſely equal to the oppoſite ∠ per Euclid, if Refraction did not alter it; but we are quite poſitive it does.

Now, if y z be the Height of the Earth's Atmoſphere, the Ray y N and z R will be in a different Direction from ☾ y

and

and ☽ z; and, by the Nature of Refraction, the ∠ y N R will be greater than the ∠ ☽ N R, and conſequently the ∠ N ☽ R will appear greater than it really is, becauſe the ∠ y N R appears leſs.

But, to make it quite clear, I have tranſpoſed the ſame (to prevent Confuſion) making Fig. 2d.

Let us ſuppoſe the Moon to be at ☽, an Obſerver at N will ſee it in the Direction N y Q, and the Obſerver at R will behold it in the Direction R z Q. Hence it is evident that the real Angle that the Moon makes with the two Obſervers, as at ☽, will be greater than the apparent Angle N Q R; and the ∠ y N R + ∠ z R N + ∠ y ☽ z will exceed 180°: Whence, by knowing the Exceſs, we ſhall be able to find the true and different Quantities of Refraction in the Sun, Moon, and Stars.

But all our Aſtronomers, to a Man, altho' without any Demonſtration, obſtinately maintain, that the Refraction of the Sun, Moon, and Stars, is preciſely the ſame; and on this Suppoſition Mr. Keill endeavours to find the Refraction of a Star by other Stars, but don't attempt it by either the Sun or Moon, and yet concludes all to be equally the ſame.

Were the Fixed Stars, the Sun, and Moon, all at the ſame Diſtance from the Earth, it would undoubtedly be ſo; but if they are at very unequal Diſtances from the Earth, as is univerſally acknowledged, it will not be ſo, I preſume. And the indefatigable and great Tycho, the Diſcoverer of Refraction, aſſerted the Quantities to be very different; tho' our beſt and greateſt Aſtronomers object to it, and ſay, that it was owing to his want of Skill or Knowledge in Philoſophy that led him into this Error. But I imagine that he made a more juſt and far ſtricter Search into the Matter than all the Aſtronomers that have lived ever ſince his Time; and in order to juſtify my Aſſertion I ſhall give the following

ILLUSTRATION.

LET the Beholder be placed at B, and let A repreſent the Height of the Atmoſphere, M the Moon, ☉ the Sun, and S a Fixed Star (Plate the 4th, Fig. 1ſt): Now, if the Obſerver beholds the Image of the Object at A (as cannot be denied) and if the Moon be really at M, the Sun muſt be at ☉, and the Star at S, all in a ſtrait Line, or otherwiſe the Refraction will be in different Directions. But it is obvious if the Refraction is equal in all theſe Bodies, that the real Angles of Altitude, or Diſtances from the Horizon, will be all different; For the ∠ M B H will be greater than the ∠ ☉ B H, and this laſt Angle greater than the ∠ S B H: Whence the Refraction of a Star at the real Altitude of 46° perhaps may be the ſame as the Refraction of the Moon at 50°, &c. as is manifeſt by the Figure; conſequently we know not the true Altitudes of theſe Bodies, unleſs we knew their real Diſtances: Whence it will follow, the taking Ten Thouſand Obſervations, from any one Obſervatory, will not be any Diſcovery: For the Obſerver at B would find either of theſe Bodies to appear at D, becauſe the Ray of Refraction directs him thither, tho' all differing in real Altitude: And if the Line B M be continued to E, ſo as the ∠ the Star E makes with the Horizon be = ∠ M B H = the ∠ the Moon makes, then the Ray M E will change its Direction without any Cauſe at M, and run to A and B; but that is impoſſible. Whence we cannot know the Quantities of Refaction of the Sun and Moon by having that of a Star.

One Year's Obſervations, at moſt, properly made at the three Places before mentioned, would abſolutely determine theſe Matters, and end all Diſputes concerning the Solar Syſtem, and aſcertain the Planets Magnitudes and Diſtances. Was the exact Quantity of Refraction truly known in theſe different Bodies, and at all apparent and real Altitudes, it would be of infinite Uſe in

Aſtro-

Aſtronomical Calculations. I think the Refraction of the Sun and Moon to be much greater than is allowed by our Aſtronomers; and I imagine my Opinion may be corroborated in ſome Meaſure by this Inſtance, viz. That the vertical Diameter of the Moon, when near the Horizon, is conſiderably leſs than her Horizontal Diameter is at that Time; which I think cannot poſſibly be in ſo ſmall a Space as about 33′, if the Horizontal Refraction is no more than that ſame Quantity. And I find by HODGSON, that in the Year 1695, at Pello, in the Latitude of 65° 53′, that when the Center of the Sun was depreſs'd 40′ below the Horizon, that he was ſeen, by Means of Refraction, at the Altitude of two Diameters; which vaſtly differs from FLAMSTEAD's Tables and others. And it is known that the whole Bodies both of the Sun and Moon have been ſeen for a conſiderable Time above the Horizion in an Eclipſe of the Moon, and probably ſo obſerved in a Valley, as moſt Towns are ſo ſituated: Whence, if a Beholder had been on the Top of ſome high adjacent Hill, he muſt have beheld theſe Bodies much longer than a Perſon ſituated in a Valley: And from hence it appears that Refraction is much greater than allowed. Mr. DE LA HIRE affirms, that Refraction is not the ſame in a Valley as on the Top of an adjacent Hill, but much greater than on the Summit; which I make not the leaſt Doubt of, becauſe the Atmoſphere is much more denſe near the Earth's Surface than on its Top; and if a Ray of Light paſſes through different Mediums, its Direction is altered at the Separation, and would deſcribe as many different right-lined Directions as Mediums. But as the Atmoſphere is not thus ſeparated, but is one continued Fluid, gradually becoming more rare in Proportion as its Diſtance increaſes from the Earth's Surface, the Path of a Ray of Light will be a Curve; but of what Kind we cannot be poſitive from any Obſervations hitherto made.

I am inclined to believe that the Quantity of Refraction is not the ſame in Summer as Winter, i. e. when the Sun or

Moon ſhould have a real equal Altitude, they would not appear ſo.

N. B. If the two Obſervers at N and R ſhould have an Opportunity to take the Sun's Meridian Altitude when he is really in the Equinoctial, or when he appears in the Zenith to an Obſerver at E, which I apprehend will be about the 22d of March and the 20th of September, and find the Altitudes at that Time equal, as I make no Doubt but they will; then may the exact Quantity of the Sun's Refraction be known at that Height; and nothing is more obvious than that theſe two Obſervers will behold the Sun, Moon, or any Planet, preciſely at the ſame Height when theſe Bodies are really in the Equinoctial: For, let us ſuppoſe the two Obſervers in 50° of Latitude, the Sun ſhould appear to have but 40° of Altitude (without Refraction); but he will appear, I preſume, more than 41° ½ above the Horizon in North Latitude; and the like in South Latitude, beyond all Doubt to me: Whence the Refraction will be almoſt three Times as great at that Altitude as our Aſtronomers allow the Horizontal Refraction to be, which is the greateſt of all. But if theſe Obſervators have not the Opportunity before-mentioned, the Obſervations which are taken before and after will determine it; but not ſo eaſily, nor perhaps quite ſo accurately.

In like Manner, the true Refraction of the Moon, a Planet, &c. may be found. By which, and by no other, Method, do I think the Quantity of Refraction can be truly determined. And if the two fore-mentioned Spectators ſhould take the Moon's Altitude when ſhe appears in the Zenith to an Equatorean, the Refraction of the Moon at that Altitude would be accurately known; and as the Moon is much nearer the Earth than the Sun, her Altitude will not be ſo great as the Sun's is, when there beheld, which is undeniably true; conſequently her refractive Angle will be very different from, and greater than, the Sun's, tho' all our Aſtronomers aſſert the contrary. — I could wiſh the Learned would truly and ſtrictly examine this Matter; for much, very much indeed, depends hereon.

But, in order to compleat the Method for finding the Sun's Diſtance and Quantity of Refraction, &c. I would have two Aſtronomers more placed under the ſame Meridian, at about 23° ½ of Latitude each; no Matter for being preciſely ſo. My Reaſon is, becauſe Refraction will be there inconſiderable, I preſume; from which ſome Advantage will accrue: For if there ſhould be none, the exact Diſtance of the Sun, &c. would be known by the Angles of Altitude and the Chord Line of the Earth; and, by comparing theſe Angles of Altitude with thoſe taken in the greater Latitudes, the exact Quantity of Refraction would be found.

CHAPTER X.

Of the ſuppoſed Cauſe of the Præceſſion of the Equinoxes.

THAT there is ſuch a Receſſion of the Points at the Interſection of the Equinoctial and Ecliptic, is perſpicuous from the Obſervations of the Antients, becauſe the real Conſtellation of Aries is now in the antient Place of Taurus, &c. &c. But that the Cauſe is owing to the Form of our Earth, as Sir ISAAC NEWTON aſſerts, is extremely doubtful, and is in no wiſe ſatisfactory to me; for whether the Earth was in Form of a Cylinder, whoſe Diameter and Altitude ſhould be equal, or even unequal, or a perfect Globe, or an oblate or a prolate Spheroid, or any one of the Five regular Bodies, &c. the Caſe would certainly be the ſame (I ſtrongly preſume).

The annual Præceſſion of the Equinoxes is now univerſally allowed to be about $50''$ a Year, or one Degree in 72 Years; and Sir ISAAC attributes $9''\ 7'''\ 204^{\text{ths.}}$ to the Force of the Sun, and $40''\ 52'''\ 52''''$ to the Force of the Moon, to make up the Sum of $50''$, which Motion, or Retrogradation, he ſuppoſes to ariſe from the Redundancy of Matter in the Equatoreal Regions, and thinks if the Earth was a prolate Spheroid, the Nodes, inſtead of going backwards, would move in Conſequentia, or juſt the contrary Way, Lib. I. Prop. 66. Cor. 21, 22; but this, I preſume, is Belief or Aſſertion only, and I openly confeſs that I cannot diſcover any Reaſon for what this great Author has ſaid for ſuch an Opinion. That it is not either mathematicall yor phyſically demonſtrated, I will venture to ſay.

All our Aſtronomers do now affirm, that the Poles of the World will deſcribe Circles round the imaginary Poles of the Ecliptic (for ſo ~~much~~ I muſt call them, becauſe nothing is really ſuppoſed to revolve thereon,), and that in the Space of 25920 Years they will compleat one entire Revolution. Mr. KEILL ſays, Pa. 78, That the Axis of the Earth always keeps the ſame invariable Angle with the Axis of the Ecliptic: But Mr. ROWNING ſays, Pa. 55, That Aſtronomers have obſerved that the Axis of the Earth does actually deviate from the Direction it formerly had; but notwithſtanding ſuch Deviation, its Inclination to the Plane of the Ecliptic remains the ſame. I own that the Poles of the World may point to different Stars in the Heavens in Time, and yet the Earth's Axis retain its ſtated Obliquity to the Ecliptic Line; but then this will overthrow or contradict the Earth's conical Motion; for thoſe different polar Stars will (I imagine) be all in a right Line, and perpendicular to the Horizon; which contradicts Obſervation.

If the Poles of the World will deſcribe Circles (in Proceſs of Time) about what we commonly call the Poles of the Ecliptic, and the Earth's Axis deſcribe the convex Surfaces of two Cones, whoſe Vertices are in the Centre of the Earth, the Axis of the Earth will continually change its Situation with the Plane of the Ecliptic (which Mr. Keill denies), by pointing upwards, downwards, backwards, and forwards.

Sir Isaac ſays, in Corollary 22d to Prop. 66. Lib. 1ſt, That if there was added any where between the Pole and the Equator a Heap of new Matter, like a Mountain, it probably might diſturb the Motion of the Globe, by endeavouring to recede from the Centre of its Motion; and if ſo, perhaps the Poles may deſcribe Circles round the Poles of the Ecliptic. But, however, no Heap of Matter is ſuppoſed to be thus ſeated; and if there was, it is not to the preſent Purpoſe: For if the Poles of the Equinoctial, or Poles of the World, do actually deſcribe Circles about the Poles of the Ecliptic, then, after the Weſtern Part, or Semicircle, which is at this Time deſcribing, is fully compleated, if we may ſo ſpeak, there muſt be then an Eaſtern Part, or Semicircle, to be compleated likewiſe. But then, I preſume, it is abſolutely neceſſary, nay it conſequentially follows, That the Earth ſhould return annually $50''$ backwards, quite contrary to what it hitherto has done. But this contrary Motion would entirely overthrow *All* Sir Isaac's Reaſoning for the Præceſſion of the Equinoxes, and would ſtrike hard againſt his Philoſophy. But that I intend not much to meddle with, tho' there are many Superfluities, Uncertainties, and Abſurdities, therein to be found, and I ſtrongly imagine that the greateſt Part of it is not of any real Uſe to Mankind.

Further. If the Poles of the Earth have a conical Motion, as pretended, I affirm there could be no Præceſſion of the Equinoxes, but the Points where the Equinoctial and Ecliptick interſect one another, would remain unalterably the ſame; for if the Earth, or Equinoctial, continually falls backward, or the Ecliptic

tic goes forward, and changes its Place, the Earth's Axis cannot poſſibly any way whatſoever deſcribe the Surfaces of two Cones, as aſſerted, which muſt appear, I think, quickly to any Artiſt, if he will attentively conſider it. If the Center of the Earth was to remain in one undiſturbed Place, the Axis may naturally enough do ſo, as above, and the common Vertex would be in the Center of the Earth; and KEILL and ROWNING, as well as others, draw their Schemes to illuſtrate this Motion, as if there was no Præceſion in the Equinoxes; which moſt certainly much weakens, if it does not totally deſtroy ,the whole intended Demonſtration: And I affirm that our Aſtronomers are not any way clear in this Matter; which I do not wonder at, becauſe I ſtrongly preſume they build on wrong Principles; the preſent received Syſtem being not the true one.

I preſume it is not poſſible that any Perſon of his own Knowledge ſhould be able to determine what Line, i. e. whether curvilineal, or ſtrait, the Poles of the World change their Situation in. 'Tis evident that the Polar-Star is much more weſterly now than it was formerly, becauſe the Signs in the Ecliptic have, as it were, driven one another Eaſtward about 30°: And if ever afterwards the Polar Stars ſhould be Eaſtward of what they have been, it will, I think, unavoidably follow, that the Points of Interſection of the Ecliptic and Equinoctial would return regularly to their ancient Situations; and Aries again reaſſume his former Habitation. But this, as I obſerved before, will be quite contradictory to Sir ISAAC's Reaſoning for the Præceſſion of the Equinoxes; for he attributes the Motion to the Form of our Earth; and ſays, in the latter Part of Corollary 22d, Prop. 66, That the Nodes will either go backwards or forwards, as a Mountain or newly added Matter happen to be nearer to the Pole or to the Equator: But I humbly conceive, let a Mountain be placed any where, the Motion of the Nodes would be juſt the ſame. I have great Reaſon to believe that this Receſſion is owing to a very different Cauſe, and a very natural one, which I ſhall explain after my Syſtem is deſcribed; but it is ſomewhat improper to do it before. I alſothink that this Motion is in a right Line, and likewiſe horizontal.

Moſt Aſtronomers, I think, affirm, that the Angle made by the Ecliptic and Equinoctial is unalterable; but I find that there are ſome who think otherwiſe, particularly M. DE CAILLE and M. BAUDOIN, who aſſert, that the Angle continually decreaſes. The true Meaning of which is, that the Sun's greateſt Declination or Departure from the Equinoctial, both North and South, is not ſo much now as heretofore; and on Examination I find that it appears ſomewhat probable. For PTOLEMY and HIPPARCHUS, two great Aſtronomers, made the Obliquity 23° 51′; and, about a Thouſand Years ago, BENIMULA, ALMAMON, ABUMANSAR, and GABER, made the Obliquity 23° 35′; next EBEN CORRA made it 23° 33′ 30″; afterwards, that great Aſtronomer TYCHO BRAHE but only 23° 31′ 30″: But our Mr. FLAMSTEAD and others, whoſe Abilities are not to be queſtioned, allowed the Obliquity juſt 23° 29′. M. DE CAILLE makes it now about half a Minute leſs.

Whether theſe Quotations are ſufficient to ſhew that there is a Change in the Inclination of theſe imaginary Circles, or rather ſome Decreaſe in Motion, I ſhall leave my Reader to judge for himſelf. That a Decreaſe of Motion will cauſe ſuch Appearance, I am quite poſitive: But if it be really ſo, I think it is not improbable, that when theſe imaginary Circles ſhould coincide, or, in other Words, whenever there is a perpetual Equinox; or otherwiſe, when no Winter and Summer appear, that then our Earth (if no other Planet) will have ſome Kind of Expiration, perhaps fall into the Sun.

CHAP.

CHAPTER XI.

A new Syſtem propoſed; by which our Earth will move on in its Orbit, and in the Equinoctial, with its Axis perpendicular to the Plane thereof (as Jupiter and Mars do); and yet Summer and Winter will exhibit themſelves even as now.

AS I imagine that I have ſhewn the preſent received Syſtem is neither conſiſtent with Nature, nor itſelf, and conſequently irreconcileable, I ſhall here take the Liberty to propoſe another, for the Examination of the learned and unprejudiced Readers; of which I hope there are a competent Number. And this new Syſtem which I ſhall propoſe, I ſtrongly preſume, will accurately agree with all Phœnomena whatſoever, and without any Intricacies, or unnatural and incredible Motions. And if there ſhould be any Objections to this new Hypotheſis, as doubtleſs there may be ſome, I think they will not be unanſwerable; altho' I do not pretend to ſay that mine is really the true one. And if I myſelf ſhould not be able fully to anſwer every Thing might be ſtarted againſt it, it might not follow from thence that the Syſtem is falſe. Perhaps an abler Pen may explain, and better account for, many Things than I can: As, for Inſtance, when it was objected to COPERNICUS, that if his propoſed Syſtem was true, it would from thence follow, that Venus would appear in like Manner as our Moon does, i. e. creſcent, gibbous, &c. He anſwered, that he did not doubt but future Ages would diſcover it to be ſo; which is abundantly fulfilled by the Help of Teleſcopes. But I expect that my Objections to the preſent Syſtem

ſhould

ſhould firſt of all be anſwered, before others are propoſed againſt mine; and I apprehend no Mathematician will think it unreareaſonable.

Now, altho' I am ſomewhat diffident of my own Abilities, and of the Truth of my imaginary Syſtem, I am not of the timerous Kind, nor ſhall I quickly be intimidated by any ſpiteful Oppoſer, if any there ſhould be; neither ſhall I be dogmatical, but will openly ſubmit, if my Objections are fairly and mathematically anſwered.

Altho' my Syſtem differs greatly from what is commonly call'd the Newtonian (but in Truth the Keplerian) I hope the Engliſh Eſpouſers thereof will not be too ſqueamiſh, becauſe I endeavour to explode it; for no great Diſhonour will be reflected, I hope, on Sir ISAAC, if my Hypotheſis ſhould be the true one. The greateſt Eclipſe, if any, will fall (I imagine) on that excellent Aſtronomer Mr. KEPLER, a German, who was the firſt Artiſt that thought of, or invented, Elliptical Orbits, for the Planets to run their Courſes in; and alſo the Inventor of that Law which is called the Univerſal Law for Planets Revolutions, of which I have largely diſcourſed already And he was likewiſe the firſt Diſcoverer, or rather Aſſerter, of this, viz. That the Areas deſcribed by a Planet round the Sun, are, in all Parts, proportional to the Times of Deſcription, whether in Aphelion or Perihelion, i. e. they ſweep or deſcribe equal Areas in equal Times round the Sun.

Indeed, Sir ISAAC has endeavoured to ſupport by phyſical Cauſes, and his unparalleled Learning, theſe very Things which were ſuppoſed to be diſcovered by the ſagacious and indefatigable Mr. KEPLER; but never pretended to claim the Inventions; of which I rejoice: And Foreigners remark, that the Engliſh are more noted for Improvement than Invention. It certainly is an improbable and unnatural Hypotheſis, and which I think muſt in great Meaſure appear from barely conſidering the Irregularity thereof; yet it is with the utmoſt Reluctance that I attcak, as it were, the noble Inventor Mr. KEPLER, or the incomparable Sir ISAAC, the worthieſt Vindicator, and the greateſt Man that ever brought Glory to the Engliſh Nation; and I think his ſtupendous Invention of Fluxions eſtabliſhes this Encomium. But if the moſt ſhining Language, united with the utmoſt intricate Problems, deviate from Truth, an honeſt Enquirer will not be biaſs'd thereby.

Sir ISAAC indeed has taken infinite, amazing, and inexpreſſible Pains; nay, and with great Accuracy alſo; and has ſolv'd ſome of the moſt ſublime Problems in Nature; and has likewiſe endeavoured to explain the Cauſe and Reaſon of the various Revolutions of all Bodies; but has not given that univerſal Satisfaction could be wiſhed for, in numerous knotty Problems; as may be ſeen in GORDON's Remarks on him and Dr. GREGORY, which I apprehend were never anſwered, altho' written a great many Years before Sir ISAAC's Death.

Now, as I ſtrongly preſume that Nature is not ſo peſter'd with Intricacies as imagined, I will here venture to publiſh to the World my Thoughts concerning our Solar Syſtem.

That the Sun is placed in the Center of our Planetary Syſtem is now allowed by all modern Aſtronomers, and to me it appears extremely reaſonable and natural both; he being the Fountain and Diſperſer both of Light and Heat. And it is alſo acknowledged, that the Sun revolves about his Axis in the Space of 25 or 26 Days; but for him to do ſo without altering his Situation, and to remain in one unchanged Place, to me ſeems very improbable; becauſe it has the Appearance of a Revolution to no Purpoſe whatſoever, and looks ſuperfluous. But certainly the All-wiſe Creator would do nothing in vain; which Conſideration, accompanied with the forced and unnatural imaginary Motion of the Earth in her annual Journey, induced me to ſuppoſe the Sun to have a ſmall circular Revolution, as perhaps from North to

South, and the Plane of his Orbit to be perpendicular to the Earth's Orbit, &c. And why any one Body in the Syſtem ſhould be exempted from Motion more than another, I cannot at preſent give any Reaſon, as all are alike inanimate: And I make not the leaſt Doubt but if Sir ISAAC was now living, and thought the Sun had ſuch a Motion, he would be able to aſſign ſome very plauſible Reaſons, that it was almoſt impoſſible for ſuch a Body to be naturally, and ſo continually, ſuſpended, in one Place in open Air, without having ſome orbicular Motion, &c. And, in order to be the better underſtood, I ſhall ſuppoſe the Sun's Orbit to lye horizontally, and the Earth's to be in the Equinoctial, perpendicular to the Sun's (tho' it may be oblique); and I ſhall endeavour to explain my Meaning by repreſenting two circular Hoops in ſuch a Poſition as that the Sun's Orbit ſhall be juſt ſo large that the $\angle ENC = \angle ESC$ ſhall be preciſely equal to the Sun's greateſt Declination $= 23^\circ\ 29'$; whence, by the Earth's revolving perpendicular to its Axis, thro' her Orbit, every Viciſſitude of the Seaſons will exhibit itſelf juſt as it now really appears, and in the moſt eaſy and natural Manner poſſible. See Fig. 2d, Plate the 4th.

Let E s W e repreſent the Earth's Orbit, N s S * the Sun's annual Courſe, and C the Center of the Sun's Orbit, as alſo the Center of all the Planets Orbits; and the Earth's and Sun's Orbits to be both compleated in one and the ſame Time, or very nearly. Now, let us ſuppoſe the Sun to be at *, and the Earth at e, and the Time the 20th of March, or the Sun in the vernal Equinox; then, when each has run a Quadrant of their reſpective Orbits, the Earth will be at E, and the Sun at N; and the Time will then be the 21ſt of June, and the Sun entering Cancer; when another Quadrant is finiſhed the Sun will be at s, and the Earth at t, and the Time the 23d of September, or the autumnal Equinox; when the next Quaters of the Orbits are finiſhed, the Sun will be at S, and the Earth at W, the Time the 21ſt of

December, or the Sun entering Capricorn; and when the laſt Quadrants are compleated, then both the Earth and the Sun will return to the Places from whence they ſet out, which Time we may call a Tropical Year.

From what is delivered it evidently appears, that an Inhabitant at the Equator will have the Sun neareſt to him when the Sun is really in the Equinoctial, which we here in England ſuppoſe to be about the 20th of March and the 23d of September; and, in like Manner, preciſely fartheſt from him the 21ſt of June and December; which to me appears moſt natural and conſiſtent with ſuch a Frame. And I cannot think that any reaſonable Aſtronomer will, after ſerious Conſideration, deny, that the Sun is neareſt an Inhabitant at the Equator, when he appears at the Equinoctial, and in his Zenith; I mean, that he cannot, conſiſtent with Reaſon, deny it, unleſs by implicitly relying on our deceaſed Aſtronomers, he obſtinately ſhuts his Eyes, and willfully ſtifles an impartial Enquiry into the Frame and Nature of our Syſtem. And our Antipodes will have the Sun juſt as far off in their Winter and Summer as we have in ours, by my Hypotheſis; which I think will naturally flow from Regularity and Juſtice. Why ſhould our Antipodes have a longer or ſhorter Summer or Winter than we have? That they both are equal, to me appears beyond all Doubt.

If the Sun's Orbit ſhould be at right Angles with the Earth's Orbit, as I imagine it is, the Days will increaſe and decreaſe in ſuch a Manner as the natural Sines of equal Arches do in a Quadrant of a Circle; and in March and September the Difference will be much greater than is ſhewn by our Tables, which are compoſed from a well known Canon in Spherical Trigonometry; and I firmly believe that nice and accurate Obſervations would abundantly confirm the Truth of what I have here obſerved: For one Week's Time about the Equinoxes makes ſuch an Alteration on in the Length of Days, that the moſt vulgar Sort of People, as well as the moſt learned, are remarkably ſenſible of the Difference.

By our Canon in right-angled Spherics the Length of Days in London differ only about 4' a Day, when the Sun is in or near the Equinoctial; and about the 20th of January and of May, they then differ almoſt 3 by the ſame Rule; which cannot agree with Experience, ſtrict Obſervations, or Truth, I am ſtrongly perſuaded.

But further: Sir ISAAC aſſerts, that the Motions of Bodies are always quickeſt when they are neareſt each other; which at preſent I muſt believe: Not that I can give any Mathematic Demonſtration or Proof of it; for it may be exactly the contrary, for what I know. Thus, let us ſuppoſe our Earth to revolve in an elliptical Orbit about the Sun, who is ſuppoſed to be fixed in one of the Foci; and it is known by his Attraction that the Planets are retained in their Orbits, or otherwiſe they would fly off in Tangents. Now, when the Earth is in Perihelion, or neareſt of all to the Sun, his Attraction, or Force, or Power, will of Conſequence then be the ſtrongeſt of all on the Earth; and he being alſo of a vaſtly greater Magnitude than the Earth, will, by his ſuperior Power (one ſhould imagine) actually retard her in her Journey, rather than haſten her: For ſhe certainly muſt of Neceſſity loſe ſome of her Strength, Motion, or Velocity, by being overcome with, or combating, a greater Power: I mean according to my ſhallow Knowledge in Philoſophy. But, if this be ſo; nay, to be ſure, it cannot be; — for, if it was, Sir ISAAC's Philoſophy ſtands on a falſe and tottering Foundation; and muſt fall to the Ground of Courſe. I ſhould be glad to have ſome better Reaſons ſhewn than our Philoſophers have hitherto, for the Truth of the received Opinion; and in ſuch a Manner as a good Geometer and Algebraiſt may underſtand the Reaſoning, and not ſoaring above the Human Species, as ſome almoſt do about the Proof of a Self-exiſtent Being, &c.

> " Mounting the high Priori Road,
> " And reaſoning downward till we doubt of God."

I would have fair and ſolid Reaſoning, and in ſuch a Manner nearly as is deſcribed by Mr. LOCKE, perhaps the greateſt and cleareſt Reaſoner that ever writ: Witneſs his Diſpute with the Biſhop of Worceſter. That Gentleman ſays, That in all ſorts of Reaſoning, every ſingle Argument ought to be managed as a Mathematical Demonſtration.

And we know that our Newtonians do boaſt much, that their Philoſophy is founded on a Rock, on Experiments, or Facts themſelves; and they ſay, that they will admit nothing as Truth without them. But I confeſs that I do not know in what Part of Sir ISAAC's Philoſophy to find the above Experiment; and if it is not there, what will become of all his Aſtronomical Laws? I believe Sir ISAAC intended the 2d Section, V. 1ſt, to demonſtrate it, by what he calls Centripetal Forces: But the Appellations of Centrifugal and Centripetal Forces, and their being of an oppoſite and contrary Nature, and juſt equal to one another, is, to me, mere Jargon, and looks very much of the ſophiſtical Kind: And they are of no real Uſe in all Nature or Aſtronomy, I boldly affirm: And if ſo, it will follow, that Sir ISAAC has taken amazing and infinite Pains for nothing at all. And I believe I may truly ſay, that he was a much greater Scholar than a Naturaliſt; becauſe he makes Nature ſo prodigiouſly laborious in all her Operations, and makes uſe of ſo many complicated Cauſes to produce one ſimple Effect. And a certain merry Author ſays, It was a ſingular Piece of Management of Sir ISAAC, to make ſo much of ſo little, or rather of nothing at all. I believe he has taken a thouſand Times more Pains about Things of no manner of Uſe or Conſequence to Mankind, than about ſuch Things as are uſeful ſul. And, if ſo, as is imagined by Sir ISAAC, it will follow, on the Baſis of my imaginary Syſtem, that the Sun and Earth will move faſteſt of all when in the Equinoctial, being then neareſt to each other, and conſequently faſter than mean or equal Time; and ſloweſt of all about the 21ſt of June and December, when fartheſt from each other; therefore, ſlower than mean or equal Time, or otherwiſe faſter in the latter, and ſlower in the former Times perhaps: From whence ariſes (I ſincerely believe) the true and only Cauſe of the Difference of Time between a well-regulated Time-piece, and a good Sun-Dial; which if ſet together about the Third of February, or the 5th of May, &c. New Style (which nearly agrees with M. DE CAILLE's Times), I could almoſt take it upon me to ſay, that a Clock would be very nearly as much faſter than the Sun the 21ſt of June and December, as it would be ſlower than the Sun the 21ſt of March and September; and in oppoſite Parts preciſely alike in Quantity of Time; and this may eaſily be experienced in one Year's Obſervations.

Now, to what I have advanced in this Chapter, I expect this Objection to be made, viz. If the Sun has ſuch an Orbit, why ſhould the periodic Time be the ſame, or very nearly, as that of our Earth? To which I anſwer thus: If we believe the Sacred Writings, as I preſume all my Readers firmly do, we ſhall have numerous, great, and indiſputable Reaſons to believe that our Earth is infinitely more regarded than any other Planet in our Syſtem; eſpecially when we conſider that the Son of God came here on Earth to live with and die for Mankind. Whence it appears highly probable, that there are no immortal Beings in any other Planet that circulates round our Sun; and, if ſo, we need not wonder why this Planet has the Preference to any other; and we have no Reaſon to doubt but that it has. Amazing and remarkable Inſtances the Holy Writ affords us, that this Earth is greatly taken Notice of. In the Battle betwixt the Amorites and

Joſhua, he, in order to avenge himſelf of his Enemies, prayed to the Lord; and then at *his* Word both Sun and Moon ſtood ſtill, and haſted not to go down for about a whole Day, until the Victory was compleated. Now, although this Expreſſion is laugh'd at by our Aſtronomers, becauſe it appears inconſiſtent with their received Syſtem, it does not carry any Abſurdity in it, if mine was ſubſtiuted in its Room: For I make no doubt but when the Earth and the Moon ſtood ſtill, but that the Sun did alſo, if not every moving Body in this Planetary Syſtem.

Another ſurprizing Inſtance is, that concerning Hezekiah; for the Sun not only ſtood ſtill, but returned quite backwards ten Degrees, as the Dial of Ahaz manifeſted; and doubtleſs the Sun with the Earth and Moon returned alike backwards in their reſpective Orbits, &c. And that the Sun did really return backwards is beyond all Doubt to me; for otherwiſe it would not be recorded as a Wonder in Scripture; for if it was not ſupernatural it needed no Notice: For, according to ROBERTSON in his V. 2d of Navigation, Problem 34, on a certain Day of the Year the Sun, or at leaſt his Shadow, will not only ſtand ſtill, but alſo naturally return backwards 12° 31' in the Latitude of 20°.

If this new Syſtem ſhould be thought abſurd, or inconſiſtent with the Laws of Nature, as to the Sun's Rotation about his Axis in 25 or 26 Days, &c. &c. let it be well conſidered that Jupiter, the far biggeſt of all the Planets, revolves about his Axis in the Space of about ten Hours; altho' he requires twelve Years to travel round his Orbit. And altho' our Earth, Venus, and Mars, are different in Magnitude, and much leſs than Jupiter, yet they do not turn about their Axes in much leſs than 25 Hours. And notwithſtanding they revolve nearly in one Time about their Axes, yet they differ widely in their Times of Revolutions about their Orbits; for Venus runs hers in about 224 Days, and Mars his not in leſs than 686 Days.

Alſo, it is to be remarked, that Jupiter is far bigger than Saturn, Venus than Mars, &c. notwithſtanding their Diſtances from the Sun ſeem to be contradictory. Whence it is extremely manifeſt, that the Planets Magnitudes do not increaſe or decreaſe in any wiſe proportional to their Diſtances from the Sun: Nor do I believe that their Periods are in any known or conſtant Ratio to their Diſtances from the Center of their Orbits, as I have already ſaid, It is alſo to be remembered, that our Earth has a Satellite; Mars has none, tho' many aſſert Venus has; but I have ſome Reaſons to think otherwiſe: I imagine the Appearance is owing to ſome Deception; as, Reflection, Refraction, &c. or ſomething of that Nature, as that of another Sun was, which appeared a conſiderable while in Queen Mary's Reign. And laſtly, let it be obſerved, that our Moon only revolves once about her Axis in an entire Revolution: All which different Motions and Magnitudes, at different Diſtances, moſt wonderfully ſhew the extenſive Power, Variety, and different Manner of the Diſtribution of the Great, Omnipotent Creator, who is not confined by any Laws whatſoever, nor like a Mechanic always follows one dull, univerſal Rule.

Now, I ſincerely think, from what has been here offered, that altho' our Philoſophers pretend to account for every Motion and Law in the Heavens, that they muſt acknowledge (if they have any Modeſty) that they are wholly ignorant of the Cauſe from whence theſe admirable Varieties proceed. Mr. ROWNING indeed ingenuouſly confeſſes, that he is not ſatisfied with Sir ISAAC's Account of the Cauſe of Reflection of Light, thinking it not agreeable to the Simplicity of Nature. But then he joins with him in this ſtrange Advance, viz. That all the known Bodies of the Univerſe may be compoſed of no greater Quantity of Matter than what might be reduced into a Globe of an Inch Diameter—!—!

Nay, our great Philoſophers pretend to give ſuch a Mathematical Account of Things, and of the Nature of the Planets (tho' ſo diſtant) and alſo of their Regions, as of a Triangle, Circle, Conic Sections, Globes, &c. which they can actually touch, and really meaſure their Magnitudes, &c. But Philoſophy is not capable of being handled in the ſame Manner as a truly Mathematical Problem, which they often find to their Diſatisfaction, would they be ſo honeſt as to confeſs it.

Why vain Man ſhould be ſo daringly bold, rather ſo ſtupid, I think, to enquire into God's Reaſons for framing ſuch a Syſtem, and adorning it with ſuch different and ſtupendous Bodies, and Varieties of Motions, I cannot conceive. If Man knows that there are ſuch Bodies as act thus and thus, it is ſufficient for him; for the Cauſes which proceed from the Will of an Infinite Being, will for ever lye concealed from a finite Creature in this State, if not hereafter. But ſo great is the towering Genius of ſome Men, that they would ſoar above their Species; as POPE ſays, " Men would be Angels, and Angels would be Gods." All my Enquiry is, how Things are; not why they are, or why they are ſo and ſo diſpoſed; well knowing, that if I employed my whole Life about the Enquiry, I ſhould be no more certain at laſt than at preſent. And Philoſophers muſt know (tho' they wlll not confeſs it) that they can give ſcarce any certain or ſatisfactory Account of the moſt common Bodies on Earth; except a very few, nay, few indeed, with reſpect to the Whole.

Now, to what I have written againſt the preſent received Syſtem of Aſtronomy, I preſume the following Objections may naturally enough be raiſed; and I know no more that can appear with any tolerable Face or Moment.

Firſt, it is ſaid, that the Sun's Diameter appears greater in Winter than in Summer; and ſecondly, that the Sun annually appears in this Kingdom eight Days longer on the North Side of the Equinoctial than on the South: But tho' theſe Things to us really appear ſo, I ſhall endeavour to demonſtrate, that the true Cauſes are not owing to ſuch Things as our Aſtronomers imagine, but highly probable to ſuch as follow.

ILLUSTRATION I.

LET B be the Place of the Beholder on the Surface of the Earth, ſee Fig. 1. Plate 5; the Arch M O, the Height of the Atmoſphere in Winter; the Arch D F the Atmoſphere's Height in Summer; and E and N the Sun in the Heavens: Make $ZE = ZN$, and the $\angle DEF = \angle MNO$, repreſenting two equiangled Rays of Light, proceeding from the Sun: Now, ſince it is evident that the Rays E F, E D, are ſhorter or leſs than the Rays N M, N O, it will follow per ſimilar Triangles, that D F is leſs than M O; conſequently the $\angle DBF$ is leſs than the $\angle MBO$, becauſe $EB = NB$: And ſince the Rays of Light are turned out of their natural and rectilineal Courſe, where they enter the Atmoſphere, which is actually the very Place which determines the Magnitude of the Object on the Retina of the Eye, it will follow from thence, that the Diameter of the Sun will appear greater when the Atmoſphere is low, which is in Winter, than in Summer when it is high: And the learned Mr. KEILL, P. 235, acknowledges, that the Atmoſphere is thus; which Difference is occaſioned by the Condenſation and Rarefaction of the Air, as is univerſally allowed.

I allow with Mr. KEILL that the Sun's apparent Diameters would be reciprocally as the Sun's Diſtances, were all Circumſtances alike; but as they are not, as is here moſt evidently ſhewn, this Demonſtration will juſtly take place, and ſhew the true and only Reaſon for the different Appearances of the Sun's Diameter.

It may not be improper to obſerve that Mr. KEILL ſays, P. 82, that the Sun's greateſt and leaſt Diameters are $32' \, 47''$ and $31' \, 40''$

40″; but in P. 277, he ſays, the Diameters are 32′ 33″ and 31′ 29″; which Difference I preſume was occaſioned by taking his Diameter in different Years; for the Atmoſphere is not always of the ſame Height when the Earth is in Aphelion, and alſo in Perihelion; i. e. not every Summer and every Winter alike: But the Sun is preciſely ſo near us one Year as another, at the ſame Times of the Year, and therefore his Diameters would be invariably the ſame at like Times, if the Height of the Atmoſphere did not alter it; for we cannot ſuppoſe (let the Syſtem be what it will) that the Sun is nearer to us in one Winter or Summer than in another. If this Difference was owing to the Diſcrepancy of Obſervations, what Truſt is there on Parallaxes?

Now, on this ſlender Footing of the Difference of the apparent Sun's Diameter in Summer and Winter, Aſtronomers conclude the Earth's Orbit to be Elliptical; which to me is amazing.

ILLUSTRATION II.

WHEN the Sun appears in the Zenith to an Equatorean, that glorious Body muſt actually be in the Equinoctial; but a Beholder in our Latitude will not perceive him there when he really is, but at ſome Diſtance therefrom. Were the Heavens confined by ſome limited Concavity, and the Sun continually ſeated therein, this Deception could not poſſibly be; but we know that the Fixed Stars are immenſely further from us than the Sun is; and if the Sun is not One Million and Half of Miles from us (as I imagine) the apparent Place will differ from the true Place conſiderably.

Let us now ſuppoſe the Sun at ⊙, Fig. 2, Plate 5, and a Beholder at B; when a Ray of Light proceeding from the Sun at ⊙ falls upon the Atmoſphere at A, it is then and there turned out of its rectilineal Courſe, by paſſing into a denſer Medium; and by the Laws of Refraction is inclined more and more to a Perpendicular, as it paſſes through denſer Mediums: And as our Atmoſphere is more denſe near the Earth's Surface than further off, this Ray of Light will deſcribe ſome Curve as A B, according to moſt Writers; and the Direction of the Inſtrument to behold the Sun will be along the Tangent B S; and the Beholder will imagine that he ſees the Sun at S. But it is plain that the Inſtrument makes the ∠ S B H with the Horizion, which is much greater than the ∠ ☉ B H, which is the real Angle the Sun makes with it: from whence it evidently appears, that the Sun was not arrived to the Equinoctial (ſuppoſing the Time to be in March) when he was beheld there; which plainly ſhews the Reaſon why our Summer appears to be longer than our Winter.

We never do really look in or ſee the Body of the Sun himſelf, except he was in or near our Zenith; which may in ſome Meaſure be explained by that common Experiment of putting a Shilling, &c. in the Bottom of a Baſon, or any other ſuch like Veſſel; and then ſtanding conſiderably further off than you can ſee any Part of the Piece, then by pouring Water you may ſee the Appearance not only of the whole Coin, but likewiſe elevated to a great Height: Yet no Perſon can pretend to ſay that he actually ſees the Piece of Money itſelf, but only its Image, as we behold our Face in a Glaſs; and the former Appearance is owing to Reflection and Refraction united; but the latter to Reflection only.

If a ſtrait Stick is put into Water in an oblique Direction, it will appear to be bent or broken at the Separation of the two Mediums, Air and Water; and the Angle may be as great as 6, 8, or 10 Degrees, &c. From whence it appears, that we do not ſee any Part of the Stick which is immerſed in the Water.

CHAPTER XII.

Of the Horizontal Moon.

FORASMUCH as many Great and Learned Men have attempted to give the World a Mathematical Account for the large Appearance of the Horizontal Moon, and have not given that Satisfaction to our Connoiſſeurs which could be wiſhed for, I ſhall here endeavour to account for the Phœnomenon in as brief and clear a Manner as I can.

GASSENDUS thought, that as the Moon does not appear ſo bright when in the Horizon as on the Meridian, that we ſee her with a larger Pupil when ſo low, which cauſes ſo great an Appearance of her Body: But this, according to optical Laws, makes no Difference in the Magnitude of the Image; and a good Optician can eaſily ſhew the Abſurdity of it.

MOLINEUX to this Opinion of GASSENDUS adds, that the Interpoſition of divers Objects on the Earth, or in the Horizon, is one Cauſe of the Appearance, and the Duſkineſs of the Moon the other. But theſe are very inſufficient to account for the Phœnomenon; for, as to the latter, we do not know of any ſuch Change in the chriſtalline Humour and Form of the Eye; and as to the former, if we lay a large Plane almoſt horizontally, ſo as to obtruct the Sight of any Objects which are in the Horizon, we ſhall behold the Moon juſt the ſame as without ſo doing.

Dr. WALLIS and DES CARTES nearly agree in Opinion, and think that the Appearance is wholly owing to the Deception of Imagination. But certainly it muſt be owing to Reality; the which I ſhall now endeavour to demonſtrate.

And firſt, let ~~it~~ it be obſerved, that it is ſometimes neceſſary to draw Schemes ſo near the Truth as conveniently may be, in order to have a juſt Idea of the Matter we are enquiring about; and I find it to be ſo in this Caſe, tho' it can hardly be done with the utmoſt Advantage: For if we roughly ſuppoſe the Earth's Semi-Diameter to be = 4000 Miles, and the Height of the Atmoſphere = 50 Miles, the latter is but $\frac{1}{80}$ Part of the former. But notwithſtanding the Diſproportion is ſo great, I ſhall proceed thus.

ILLUSTRATION.

LET C repreſent the Center of the Earth, Fig. 3. Pl. 4, AB a Spectator on its Surface, A D an Arch of the Atmoſphere, and Z M the Concavity of the Heavens: Now, ſuppoſe the Moon at Z, then the two exterior Rays of Light, proceeding from her when arrived to the Atmoſphere, will only enlighten the Arch A a, where the Image of the Object is painted: And that we do behold the Sun's and Moon's Images both at the Top of the Atmoſphere is indiſputable, becauſe we ſee them as plain after they are really below our Horizon as when above it. But if we ſuppoſe the Moon in the Horizon as at M, then two equiangled Rays of Light will enlighten the Arch A e, which is vaſtly larger than the Arch A a, altho' the $\angle$ a Z A = $\angle$ A M e, on Account of the Obliquity. Whence, of Conſequence, the naked Eye will behold a far greater Image, or Portion of Light, painted there, on that Part of the Atmoſphere where the Object is beheld, than in any other Situation of the Moon, as is extremely evident; and this is one of the true Reaſons why the Moon appears ſo large when in the Horizon, I imagine.

The other Reaſon that I ſhall offer to explain the Phœnomenon is, That the Moon is almoſt 4000 Miles further from an Obſerver when ſhe is in the Horizon than when in the Zenith, and conſequently the Space A B is greater than m n, which is ſuppoſed to be juſt equal to a A; whence this muſt alſo really contribute to the large Appearance of the Horizontal Moon, and both theſe Cauſes together here mentioned are, I preſume, fully ſufficient to account for this Phœnomenon truly.

But a Micrometer baniſhes or removes all the falſe or deluſive Light, and there remains no Appearance of Light more than really is in a Subtenſe or Chord Line of an Arch (equally diſtant from the Center of the Moon,) as m n.

CHAPTER XIII.

Of the probable or true Cauſe of the Præceſſion of the Equinoxes.

I Have already ſaid, that I had ſome Reaſons to believe that the Receſſion of the Points where the Equinoctial and Ecliptic interſect one another was not owing to ſuch Cauſes as Aſtronomers have hitherto aſſigned, and for the Confirmation of my Opinion I ſay thus:

I cannot pretend to aſſign any juſt Reaſons for ſuch an Alteration or Change on the Baſis of the preſent received Hypotheſis; and 'tis obvious from what I have already ſaid, that our Aſtronomers are much puzzled to explain the Matter in their own Way, and give a ſtrangely complicated, unſatisfactory, and, I think, contradictory Account, why or how there is ſuch a Receſſion. I have hinted, that I do imagine that the North Pole of the Earth does not deſcribe any Circle in the Heavens, but continually points more and more Weſterly only, as Mr. **Keill** plainly aſſerts, P. 78. and that the Departure or Change of Pointing in the Heavens is not only in a Right Line, but likewiſe accurately horizontal; and from my ſuppoſed Syſtem this Alteration naturally and moſt ſimply exhibits itſelf, without any Toſſings and retrograde Motions.

ILLUSTRATION.

LET N E S W, Fig. 3d, Plate 5th, repreſent the Heavens in an horizontal Poſition at the Equator, N the North Pole, &c. Let A B repreſent the Earth's Orbit, and E W its Plane at this Time; from whence it is manifeſt that the Axis of the Earth will point preciſely to N. Now, let us ſuppoſe the Equinoxes to fall back one Degree, which it will 72 Years hence; then if the Earth changes her Orbit, and its North Pole inclines more and more Weſterly $50''$ a Year, it will be come in the Situation of C D, and the Axis will then point to P, which we ſuppoſe one Degree more Weſtward than at preſent, without any compounded or irregular Motion whatſoever: And if the Earth's Orbit continues nearly in the ſame Part of the Univerſe as it is now (and doubtleſs it will) and neither higher nor lower (if theſe Expreſſions are ſuitable, or to be underſtood, which I hope they may) then will the Line of Departure be truly Horizontal; and in the Space of 25920 Years the Earth's Orbit will return into itſelf again, and the Poles of the World compleat a Circle round the Heavens: And thoſe Fixed Stars, which are now due Eaſt, will in the Space of 12960 Years be due Weſt, &c. i. e. on the Suppoſition that the Axis of the Earth always points juſt North and South; and the Earth's Orbit will be in the Plane H I in the Space of 12960 + 72 Years.

A Queſtion now to this may naturally enough ariſe, which is, What is the Cauſe or Reaſon of this Change? To which I can only anſwer, that I know of no other Reaſon but this, viz. That if the Sun circulates his Orbit from North to Weſt, &c. that when he comes in the Plane of the Earth's Orbit, which is twice in the Year, as at ⊙, that then by his ſuperior Magnitude or Attraction he endeavours to carry the Earth along with him in his Journey; and doubtleſs as they are then neareſt together, according to my Syſtem, his Attraction will have ſome Effect on the Earth, to move it ſomewhat that Way, which he himſelf is moving; and, if ſo, this will in the eaſieſt and cleareſt Manner explain the Change of the Pointing of the Poles of the Earth, or what is called the Præceſſion of the Equinoxes.

Thus have I now ventured to lay my Writings before the World, with a Deſign to make ſome Diſcovery, or, at leaſt, Improvement; and not with an Intent to affront any Perſon, or Body of People whatſoever, and therefore I hope I ſhall meet with candid and ingenuous Treatment: And if I ſhould not be right in every Advance I have made, and even if I ſhould be apparently wrong in ſome Things, I beg my Readers would kindly inform me thereof, that I may know my Errors; and then I will openly acknowledge them, and be truly thankful for ſuch Information. And if I ſhould not be preciſely conſiſtent in every Part, I hope the ingenuous Reader will make ſome Allowance, as the Work is entirely new, and of a difficult Nature; and alſo becauſe no Aſſiſtance has been given me in compiling it; and having likewiſe accumulated the little Knowledge I have without any Preceptor; which perhaps may be the Occaſion of my running out of the beaten Tract, not being biaſs'd by authoritative Education.

One Thing I preſume is on my Side, and that is, the Advantage a Writer on Mathematicks has over another who writes on really diſputable Subjects; particularly thoſe of Religion, which depend either on the Cuſtom of the Country or the Caprice of weak People, as one of the beſt Mathematicians perhaps in Europe (particularly in the Inverſe Method of Fluxions) has already obſerved in his Preface to a learned Treatiſe of Mechanicks. For no Man can alter the Nature or Quantity of a limited Angle, or its Sines, Tangents, or Secants: Neither change the Nature or Property of a plain or ſpherical Triangle, a Circle, Ellipſis, &c. but they muſt remain invariably the ſame throughout the World. And therefore if any Antagoniſt appears, we cannot diſagree in any of theſe Figures, &c. which I think muſt reduce the Diſpute to a ſhort one.

Doubtleſs there may be Objections; and I ſhall with Pleaſure endeavour to ſolve them, if candidly propoſed: But do firſt expect that mine ſhould be anſwered, or attempted at leaſt, as I have already mentioned, as it cannot be unreaſonable.

It may be urged, that the preſent received Syſtem is the true one, becauſe the Calculations of Eclipſes, &c. nearly agree with Obſervations. But we well know, that whatever Syſtem was embraced, whether the Copernican, Ptolemaic, Tychonic, or Semi-Tychonic, that the Calculations of Eclipſes, &c. always nearly agreed with Obſervations; whence no Streſs can be laid on this Remark. But the Reader will remember that I have produced a ſtrong Inſtance againſt our Syſtem's agreeing with Obſervations.

There poſſibly might be ſtarted one Objection more, and that is, If my Syſtem is the true one, why don't I proceed to the Calculations of New or Full Moons, Eclipſes, &c. and ſee whether the Calculations will be more accurate than the preſent, or whether the Work will be much abridged. To which I reply, that firſt I would have my Methods tried for finding the actual Diſtances of the Sun and Moon; by knowing which, we ſhould be able to find their real Magnitudes: And when this is done, and the Nature of their Orbits found, which at preſent is not known, I am fully perſuaded there would not be wanted half the Tables which are now made uſe of, and conſequently a Calculation would not require half the Figures which are now unavoidably uſed. Further, I preſume it would be very imprudent to begin to ſet up new Tables befote this Tract has been fully and ſtrictly examined by more learned Perſons than myſelf; and if they cannot overthrow my Objections, and diſcover ſome Abſurdity in my Hypotheſis, then there will be proper Encouragement for compoſing a few Tables, which will be no way difficult; for there is more Labour than Skill required in ſuch Matters.

AN

AN APPENDIX

Concerning Sir ISAAC NEWTON's Three Laws of Motion, which make ſo great a Noiſe and Figure amongſt our Philoſophers.

FIRST LAW.

EVERY Body perſeveres in its State of Reſt, or of uniform Motion, in a Right Line, unleſs it is compelled to change that State by Forces impreſſed thereon.

Sir ISAAC*'s Explanation.*

“ Projectiles perſevere in their Motions ſo far as they are not retarded by the Reſiſtance of the Air, or impelled downwards by the Force ot Gravity. A Top, whoſe Parts by their Coheſion are perpetually drawn aſide from rectilinear Motions, does not ceaſe its Rotation, otherwiſe than as it is retarded by the Air. The greater Bodies of the Planets and Comets, meeting with leſs Reſiſtance in more free Spaces, preſerve their Motions, both progreſſive and circular, for a much longer Time.”

REMARKS.

HERE is a great Secret communicated indeed, informing us, that every Body will remain where it is fixed, unleſs it be moved out of its Place; which, I ſuppoſe, all Mankind are ſenſible of, without any Philoſophy; nay, every Child knows it. Now, what can be drawn from all this I ſhould be glad to know. As to the Spinning of a Top; for Sir ISAAC to aſcribe its Ceſſation wholly to the Air, we know that That is the leaſt Part of Retardation. If he had thrown one Top on a hard ſmooth Marble Stone, and another on ſome ſoft Ground, he would have found Friction to be the chief Cauſe. That a Body will naturally run a Right Line is doubtleſs true, and what every body allows, as a Bowl without a Bias will along a ſmooth horizontal Green, if delivered in a Right-Lined Direction. But how does this agree with our Earth's ſuppoſed Motion? Not at all!— Whence there needs ſome other Law to be invented to account for the ſuppoſed Motion of our Earth. No Law extant is ſufficient.

SECOND LAW.

THE Alteration of Motion is ever proportional to the Motive Force impreſſed; and is made in the Direction of the Right Line in which that Force is impreſſed.

If any Force generates a Motion, a double Force will generate double the Motion, a triple Force triple the Motion, whether that Force be impreſſed altogether, and at once, or gradually and ſucceſſively. And this Motion (being always directed the ſame Way with the generating Force), if the Body moved before, is added to or ſubducted from the former Motion, according as they directly conſpire with, or are directly contrary to, each other; or obliquely joined, when they are oblique ſo as to produce a new Motion compounded from the Determination of both.

This

plain

This is ſo ~~true~~ that I believe no body will attempt to deny it, and Inſtances are needleſs.

Now to the third and moſt wonderful Law.

THIRD LAW.

TO every Action there is always oppoſed an equal Reaction; or the mutual Actions of two Bodies upon each other are always equal, and directed to contrary Parts.

"Whatever draws, or preſſes, another is, Sir ISAAC ſays, as much drawn or preſſed by that other. If you preſs a Stone with your Finger, the Finger is alſo preſſed by the Stone. If a Horſe draws a Stone tied to a Rope, the Horſe will be equally drawn back towards the Stone: For the diſtended Rope, by the ſame Endeavour to relax or unbend itſelf, will draw the Horſe as much towards the Stone as it does the Stone towards the Horſe, he ſays; and will obſtruct the Progreſs of the one as much as it advances that of the other. If a Body impinge upon another, and, by its Force, change the Motion of the other, that Body alſo (becauſe of the Equality of the mutual Preſſure) will undergo an equal Change in its own Motion towards the contrary Part. The Changes made by theſe Actions are equal, not in the Velocities, but in the Motions, of Bodies; that is to ſay, if the Bodies are not hindered by any other Impediments. For becauſe the Motions are equally changed, the Changes of the Velocities made towards contrary Parts are reciprocally proportional to the Bodies. This Law takes Place alſo in Attractions, as will be proved in the next Scholium."

Now, as to this mighty Law, I freely acknowledge I do not underſtand it, tho' the Foundation of all our Philoſophy; neither will I be bantered into it without Reaſon, nor ſay I underſtand it, when I do not, as moſt of our Philoſophers do: Nor will I be ſuch a Coward as not to oppoſe what I think is abſolutely wrong, or has no Meaning, neither any Foundation in all Nature; nor will I implicitly rely, as moſt do, on the greateſt Names, &c.— Many Gentlemen have been ſignifying to me, that Sir Isaac's Laws are indiſputable; but I think far otherwiſe of them; and I here call upon his beſt Advocates to contradict me (and, if they can, they are Cowards if they do not) and uſe me as [illegible] as I deſerve; for I am reſolved, if it is poſſible, to get out the Truth, if I openly ſuffer for it. For it is much better for one Man to ſuffer, than for the whole World for ever to remain in Ignorance. I fear not the Laſh of a calm and good Mathematician; and as to the Unmathematic, I matter not.

If a Gentleman, becauſe he thinks his Learning is ſuperior to all Mankind, ſhould impoſe a Law on them which they do not underſtand, and are unable of diſputing it with him; and the Impoſer at the ſame Time not capable of giving a clear or reaſonable Explanation of it himſelf, I imagine 'tis ſomething ſo unpardonable, ſo malignant to Society, of ſo infringing a Nature, and ſo great an Impoſition, as the Laws of no Nation under Heaven will pretend to juſtify. For my Part, I freely acquaint the World that I have not Education enough to find proper or ſatirical Words to paint or expoſe ſuch a Perſon, if any ſuch there is: And I think that the Eloquence of Cicero and Demosthenes united would fall vaſtly ſhort in colouring it.

Firſt Part of the Law.

TO every Action (without Exception) there is always oppoſed an equal Reaction.

Whatever draws or preſſes another is as much drawn or preſſed by that other, the great Sir Isabc ſays, if you will believe him.

Firſt, as to drawing: If I ſit in a Chair, and have a String faſtened to a Ball at ſome Diſtance from me, by my gathering the String up in my Hand, ſhall I not draw the Ball home to my Chair, without moving myſelf out of my Place, or the Chair either? Now, I ſhould be glad to know how this Reaction can be ſtrictly and really equal on me, or the Chair, when neither move. This is, I think, out of the Reach of Compariſon, and is a moſt daring, inconſiſtent, and ſhameful Aſſertion, I preſume.

Next, as to preſſing. If I am walking along a Clay Field, with a Stick in my Hand, and ſhould lean on it every ſtep ſo as to make an Impreſſion in the Clay, are not theſe Holes left in the Surface, and will ſo ever remain if untouch'd? Elaſticity will not recover it: But in all this, my Stick is the ſame as at firſt, and my Hand likewiſe; the Clay having made no Impreſſion or Change on either. But this Gentleman boldly tells us (and others from him), That if a Horſe draws a Stone ty'd to a Rope, that by the Rope's endeavouring to unbind itſelf, it will draw the Horſe ſo much towards the Stone as it does the Stone towards the Horſe! Now I wou'd remark, if there is any Meaning in the Words at all, that the Stone and the Horſe will always keep one invariable Diſtance, if the Rope is uniformly ſtretched: And I do not believe the Stone pulls the Horſe backward as much as the Horſe pull the Stone forwards, becauſe I ſee the Stone following the Horſe.

He takes it for granted, I mean our Great Lawgiver, that the Rope will endeavour to unbend or relax itſelf; but he gives no Reaſons for it, tho' that is not very ſtrange in his Writings: And whether it ſhould untwiſt itſelf or not, it is not to any Purpoſe whatſoever.

Now, I ſhould be glad to know what can be picked up from theſe Contradictions, and I would almoſt ſay Nonſenſe.

As to the latter Part of the Law, That the mutual Actions of two Bodies upon each other are always exactly equal!

If any Perſon ſhould give me a full Blow on my Head with a Sledge, or otherwiſe cleave my Skull ~~Head~~ with a Sword, 'tis plain either of theſe Inſtruments will have a ſad Effect on me. But what contrary Effect my Head will have upon either of the Weapons I cannot explain.

If a Firſt Rate Man of War, in full Sail, ſhould run againſt a little quieſcent Boat, would it not carry the Boat along with her in the ſame Direction? And would this Ship be ſent or driven backwards?

Newtonians! I call upon you to ſhew the Actions to be really mutual and equal. Were any two Bodies of equal Denſity and Magnitude moving with the ſame Velocity, one towards another, in a ſtrait Line, theſe Bodies, when they met, would moſt probably be quieſcent; and then indeed the Action would be equal in a ſtrict Senſe. But who knows but the Word *equal* may ſometimes mean *unequal*, &c.? or rather proportional.

Now, I wonder what an honeſt, true, and unſophiſtical Geometer, or even a Philoſopher, that is not already biaſſed, would ſay to this:—Say, that the poor Head was only paſſive, and likewiſe the little Boat, and could not make equal Reſiſtance. Now, is it reaſonable to think this ridiculous Law, as I imagine it, ſhall be a Baſis for all our Philoſophy?

His Invention of Centripetal Forces, as he calls it, is full as impertinent, and as falſe as this Law: But, I think, I may juſtly ſay of Sir ISAAC as he did of LEIBNITS, BERNOULLI, &c. concerning Solutions of nice Queſtions, That I have much better Employment for my Time, and write to ſome Purpoſe to releaſe Nature from a Multitude of Difficulties: Becauſe GORDON has effectually ſtruck this Invention to pieces, and ſhewn the Fallacy thereof.

And I have fully proved the Whole is a mere Jeſt, and Impoſition on Mankind; and nothing but a Bugbear to frighten the Unlearned.

Whence it follows, that there is no Uſe at all in his third wonderful Law; nay, it ~~they~~ ſeems to be contrary to Reaſon, common Senſe, and Experience. His Beginning is ſo very bad, I imagine, that a reaſonable Perſon, and not previouſly biaſs'd by Education, has no Encouragement to follow him.

When a Man firſt learns the common Algebraic Axioms, he is extremely ſenſible that they are undeniably true; though he cannot then perceive their unexpected, extenſive, and amazing Uſes and Advantages. But Sir ISAAC's Law hath not the Appearance of either Truth or Reaſon; and yet many believe him, as they ſay. ~~But I~~ muſt obſerve that, in my ſmall Circle of Acquaintance, I have heard many harangue on the incomparable Sir ISAAC NEWTON's wonderful Diſcoveries; when, at the ſame Time, theſe multiloquous Pedants have not been able properly to read him, much leſs underſtand him: They have not properly known either Spherick Trigonometry, Geometry, or Algebra; and yet theſe Perſons would eſtabliſh a Mathematician's Reputation. For my Part, I ſhould much rather have the Praiſe of the diſcerning few, than a thouſand Huzzas of the Multitude, or Unlearned.

Sir ISAAC confeſſeth that his Philoſophical Searches into Nature are wholly deſigned for the Explanation and Laws of our Planetary Syſtem: Conſequently if the Syſtem is falſe, as I thihk I have largely and clearly proved by undeniable Arguments, his Philoſophy is vain, falſe, and of no Uſe or Signification whatſoever to Mankind.

I beg I might not be miſunderſtood; for I do not ſay that all Sir ISAAC's Experiments are falſe, &c. for we know a Multitude of them are true; but then what I ſay is, That thoſe are of no ner of Uſe to our coming at the true Knowledge of our Solar Syſtem, and I inſiſt upon it; though he ſays it was all he aimed at. Whence this Gentleman not only ſpent much of his Time in vain, but likewiſe led the whole World aſtray. And it is very remarkable that Sir Isaac in the Beginning of his Syſtem of the World ſays, that thoſe Principles of Philoſophy are not Principles Philoſophical, but Mathematical; which truly and plainly indicates they are two different Things; and yet it is evident he has made uſe of that Method which is moſt remote from the Purpoſe: For doubtleſs he found Nature inſufficient to ſupport him, which ſeems to be confirmed juſt after; for he ſays, that he had compoſed this third Book in a popular Method, ſo as to be read by many: But when he found that fair Reaſoning would fail him, he had Recourſe to ſuch a Method as ſcarce any Perſon underſtood; and ſuch as is quite unfit and unnatural, and conſequently inconcluſive and unſatisfactory.

AN Additional

ACCOUNT

Concerning the Motion of the Earth, &c.

I Have ſaid in this Chapter the third that there may be a Poſſibility, tho' not a Probability, that our Earth ſhould have ſuch a Motion as is imagined, knowing the Great Creator is Omnipotent; but on further Conſideration, I can hardly ſuppoſe it to be poſſible, without believing continued or unceaſing Miracles: For let us ſuppoſe the Earth to be always travelling in the Ecliptic Line, with its Axis pointing North and South, and let E W, Fig. 7, Plate 1ſt, be the Equinoctial, and let S be the Eaſtermoſt Part of the Earth's Orbit, and N the Weſtermoſt Part; from which Place let the Earth be moving towards S, then it undeniably follows that the Earth is continually approaching more and more to the South, until it arrives to S, the extreme Part of its Orbit Eaſtward. Now, I ſhould be extremely glad to know, if our Aſtronomers can inform me, by what Power, &c. the Earth's Direction is inverted. What is the Cauſe of this Stop, as it were, and Change of Direction, or the contrary pointing, ſhifting, or creeping backwards of the Earth, in its Revolution? For, inſtead of her running a Courſe then, 23° ½ from the Eaſt towards the South, the Earth muſt run or point the like Number of Degrees from the Weſt, towards the North. But theſe are ſuch contrary Motions or Directions, &c. as nothing leſs than the Belief of a continued Series of Miracles, I preſume, will countenance. Why muſt the Earth be more inclinable to change her Direction in one Part of the Orbit than in another? I affirm, no good Reaſon can be ſhewn.

By my Hypotheſis our Earth is continually in the Equinoctial, and unalterably moving in one Plane, and in one Direction; which I aſſert is accurately agreeable both to Reaſon and Nature, tho' contrary to the forced Belief of our preſent Set of Aſtronomers, whoſe Power nor Skill I fear not; tho' ſome I believe (could they vent their Malice) would puniſh me ſo long as the famous GALILEO (who firſt diſcovered Jupiter's Satellites) was impriſon'd in the Inquiſition for maintaining the Motion of the Earth about the Sun.

N. B. I think the great Eccentricity of Mercury's Orbit is almoſt a Confirmation of the Truth of my Syſtem, becauſe it can moſt naturally and eaſily be accounted for by my Hypotheſis, but not at all by the preſent one, I think: For the tranſverſe and conjugate Diameter of this Planet's Orbit to differ ſo vaſtly as Mr. KEILL acknowledges they do, Page 171, I here boldly affirm that no good Reaſon whatſoever can be ſhewn for it, if the Sun is fixed in one of the Foci of its Orbit, as is univerſally allowed. Why ſhould it differ ſo vaſtly from the Orbits of all the reſt of the Planets? What can be the Reaſon or Occaſion of ſo much Difference in Diameters? By my new-invented Hypotheſis it is ſo eaſy to be conceived, and accounted for, as any the moſt ſimple Motion in all Nature; and I think I may explain this Planet's Orbit as well by Words as by any Mathematical Scheme.

ILLUSTRATION.

LET us ſuppoſe the Sun's Orbit to be repreſented by a circular Hoop of one Foot in Diameter, and to be ſuſpended horizontally; and let us alſo imagine another circular Hoop to repreſent Mercury's Orbit regularly to circumſcribe the Sun's, and three Feet in Diameter, and to be placed at Right Angles with the former: From whence it is evident that Mercury may be at the Diſtance of one Foot from the Sun, when neareſt to him; and ſometimes he may be nineteen Inches from him: And theſe real Diſtances may appear to us either to be diminiſhed, or increaſed greatly, according to our Situation.

If our Earth's Orbit was to be repreſented by a circular Hoop of 20 Feet in Diameter, there would be but a ſmall Eccentricity in the Orbit, as we find it. For our Earth could not be nearer the Sun than 9 Feet and half, nor farther from him than 10, 01. Hence, I preſume, we gain an Idea, and the true Reaſon why the Eccentricity of the Earth's Orbit is ſo ſmall, and Mercury's ſo great.

Now, it muſt be here obſerved, that I have taken our Aſtronomers Aſſertions for Truth: But it is impoſſible they can be poſitive, on Account of the numerous and divers Situations of our Earth, and the Planet that we are ſearching the Eccentricity of. Again:

That the Mountains in the Moon, tho' ſo ſmall in Compariſon to our Earth, ſhould exceed the higheſt Mountains on this Globe by three times the Height, to me ſeems quite incredible, altho' that truly great Aſtronomer, Mr. KEILL, P. 107, inſiſts upon it. But his Error may ariſe from the Demenſions of the Moon, which he takes for granted is known; and its Semidiameter, he ſays, is 1182 Miles. But if it is not ſo great, and no Aſtronomer can be ſure it is, his Demonſtration proves abortive.----- The Methods Aſtronomers take for finding the Magnitude of the Moon, from its apparent Diameter, cannot be depended on, becauſe we know not the Law or Quantity of Refraction, as I ſhall abundantly prove; and our Aſtronomers differ greatly. KIRCHER makes the Moon's Diſtance $62\frac{1}{2}$, and TYCHO but $56\frac{1}{2}$ Semidiameters of the Earth.

Note. If any Gentlemen who are inclinable to believe that the Moon's annual Orb is compoſed of 12,368 different Epicycloids, or otherwiſe nearly Segments of Circles, inſtead of one continued waving, inflexional, or retrogreſſional Curve; and ſhould think I have not ſaid ſufficient to overthrow their Opinion, I will here add, that the Moon's Motion alone moſt manifeſtly contradicts them. For the Moon, according to theſe Gentlemen's Opinion, would appear to move in the Heavens faſteſt of all, and very conſiderably faſter when at Full than when ſhe is new; for the diurnal Motion of the Moon from the Sun for many Days, about the Time of every Full Moon, would vaſtly exceed 12°; and her apparent Motion, at the Time of every New Moon, would be ſloweſt of all, and fall extremely ſhort of 12°, perhaps 2 or 3 Degrees, as the leaſt Inſpection of the Fig. 2d, P. 195, which is mentioned in P. 28, would abundantly ſhew, and convince an impartial Enquirer; for it would be almoſt ſtationary for ſome Days.

But I preſume no Aſtronomer will allow of ſuch Phœnomena, becauſe contrary to Obſervation. That the Moon has a great Number of ſeeming Irregularities is evident; and Mr. KEILL ſays, P. 103, That it is very ſurprizing that the Moon which is ſo near us ſhould be of ſuch difficult Acceſs; and that it ſhould be ſo hard to find out her Ways, and the Cauſes of all her Irregularities. But I ſay, was the true Theory, or Motion, of the Moon fully known, and the received Syſtem ſhould be the true One alſo, I ſtrongly preſume there would be no ſuch great Difficulties to be met with in tracing her Path. Her Diameter appears different at different Times; and Mr. Azout ſays, that ſhe ſometimes appears to be 33′, and ſometimes only 24′ 45″. However, other Aſtronomers make not the Difference ſo great. Was it ſo, I preſume I could demonſtrate that the Moon's Diſtance from us cannot poſſibly be ſo great as is generally allowed.

As to the different Denſities of the Planets, &c. they are quite uncertain; and if they were actually known, its Knowledge is of no manner of Uſe whatſoever in Aſtronomy, that I can find, notwithſtanding the greateſt of Mathematicians has taken ſuch infinite Pains to enquire into and diſcover it.

Our Aſtronomers tell us that the naked Eye can never ſee at one Time in our Hemiſphere many more than a thouſand Stars; which I apprehend is a Miſtake, for we know that the Stars are infinite. I own that after a naked Eye has gazed ſome Time, and ſelected any certain Number, or Conſtellation, that it cannot then ſee ny more: But when a Perſon comes immediately out of a dark Room, and finds the Heavens clear, he does then actually behold many Thouſands of Stars; but ſtedfaſtly gazing a ſmall Time in one limited Space, then the greater Lights of Conſequence extinguiſh the ſmaller ones, and render them inviſible for a Time. But if you remember the Poſition of the vaniſhing Stars, and try the Experiment again, you wlll find the very ſame Number and Appearance as at firſt, preciſely in all Reſpects.

THE

THE SUPPLEMENT

CONCERNING

LIGHT and its PROPAGATION.

TO pretend to give a nice philoſophical Definition of Light, as ſome Great Men have attempted, and fully to explain the natural and real Cauſe of it, and all its Properties, is as needleſs as it is impoſſible; for every Perſon, almoſt, knows what is generally meant by Light, which is ſufficient for the preſent Purpoſe.

I humbly conceive that Light is not progreſſive from any Star, or our Sun, altho' aſſerted by our modern Philoſophers; but quite inſtantaneous, ſo far as it ſtrongly reaches, as all the ancient Aſtronomers allowed; the which may, I think, be illuſtrated thus:

Let us ſuppoſe our Sun, or a Star, to be a fiery or luminous Body, ſuſpended in the Univerſe, and of a ſpherical Form; and alſo ſimilar or homogeneous in all its Parts; then, if ſo, this Body will extend its Rays alike to all Parts equally diſtant from his Center. And ſince we muſt ſuppoſe the Rays of equal Extenſion, we muſt likewiſe ſuppoſe them continual, and not by Fits and Starts, to increaſe and decreaſe in their Length; and if this is allowed, as it certainly muſt, I imagine, we muſt conclude that the Light proceeding from ſuch a Body as our Sun is, muſt be quite inſtantaneous: For all the Space that is enlightened by this Body is conſtantly and uniformly full, and after one and the ſame Manner; and therefore a Perſon will diſcern the enlightening Object as ſoon at one Place as another, provided he is not near the utmoſt Limits of the Light diſperſed: But a Perſon who is neareſt the luminous Body will behold it largeſt and brighteſt, tho' not ſooneſt.

The whole and only Proof our Aſtronomers have for the Motion of Light, or its being propagated in Time, given us by ROMER, is drawn from the Eclipſes of Jupiter's Satellites; which I think to be very inſufficient; for if a Satellite is involved in total Darkneſs for a conſiderable Time in Jupiter's Shadow, as we know it actually is, it has then no Light at all, being an opaque Body: But as this Moon by Degrees emerges out of Jupiter's Shadow, it begins to be luminous, and to become capable of reflecting its borrowed Light again; and is, as it were, an entirely new Body; and from the weak and and faint Light that it is endued with (by ſlow Degrees)

grees) it cannot poſſibly emit the languid Rays of Light on a ſudden, to immenſe Diſtances; but muſt gradually, as it is received, diffuſe its increaſing and borrowed Light again; and conſequently muſt take up longer Time to reach a great Diſtance than a ſmall one: And this I ſtrongly apprehend is the very true and only Reaſon why we find thoſe Satellites Eclipſes to happen ſooner when the Earth is in one Part of her Orbit than in another, and is not any manner of Proof whatſoever concerning the Light produeed by our Sun or a Fixed Star. Whence it will follow, if I am right, that all what Dr. BRADLEY has ſaid, concerning the Aberration of Light, falls to the Ground immediately. But let us at preſent ſuppoſe Light to be propagated in Time from the Stars, as he imagined, and examine his own Account, and ſee how it agrees with his Suppoſitions.

I own I have read his Account with ſome Attention, but cannot perceive he has given any Thing like a mathematic Demonſtration of what he intended; but whether it is owing to my Incapacity, or to his ſeemingly confuſed and ſuch different Accounts of the Phœnomena, I ſhall leave my Readers to judge.

For my Part, I cannot conceive what Idea this Gentleman entertained of Light; for it ſeems to me as if he imagined that a Star produced but one Ray of Light only; but we know it ſpreads the Beams alike all around.

round it: And I think we cannot ſuppoſe the Sun to withdraw or contract his Beams by Starts, and diffuſe or ſhoot them out again alternately. But in order to make the moſt of the Argument for our Moderns Opinions, we will ſuppoſe our Sun to be continually ſending forth new Rays, or Beams of Light; and that his Body daily decreaſes in Diameter by loſing his fiery Particles, and that there is no Supply added; the Conſequence will be only this, viz. That the Rays will decreaſe in Heat and Extenſion in Proportion to the Diminution of the Body: For as the Particles fly off, the Places they poſſeſſed will be filled with other Particles of the ſame Magnitude and Nature; for there will be no Vacancy or Space unfilled, nor can it be imagined, becauſe the Particles will be continually in Motion, and, as it were, be driven forwards by the hindermoſt, or thoſe neareſt the Sun.

Mr. **Bradley** ſays, that his new-diſcovered apparent Motion of the Fixed Stars cannot be owing to a Nutation of the Earth's Axis, becauſe a little Star almoſt oppoſite in right Aſcenſion to the bright Star in the Head of Draco did not alter its Declination only about half ſo much as the other remarkahle Star in the forementioned Conſtellation; which Reaſon or Aſſertion gives me room to think the Doctor was not well skilled in Mathematical Knowledge; for which bold Opinion I ſay thus:

It is very reaſonable and natural to imagine thoſe Stars which are fartheſt off from us ſhould appear ſmalleſt, and therefore it is very probable that the little Star Mr. BRADLEY ſpeaks of is farther off from us than the bright Star ~~in~~ Draco; and, if ſo, then the Difference of Declinations, which ſo puzzled the Doctor, will, in the moſt eaſy Manner, be truly and geometrically accounted for, from a Nutation of the Earth's Axis alone.

For the Sake of Simplicity and Eaſe, we will ſuppoſe the Beholder at B, or at the Equator, Fig. 7. Pl. 2. and that the Stars P and O will be accurately in his Zenith in June and December, agreeable to Dr. BRADLEY's Obſervations, and then the Earth's Axis will be repreſented by E H. Now let us next ſuppoſe the Earth's Axis in September to be in the Poſition D G, and in March in I F, and then draw Lines from the Beholder at C and A, and thro' the Stars O and P, and unto K L M N; from whence by Inſpection it is extremely evident that the Arch K N is greater than the Arch L M, and in Proportion to the different Diſtances of thoſe Stars from the Beholder inverſely; notwithſtanding the amazing Sagacity (as ſome late Authors have entitled the Diſcovery) of our late Regius Profeſſor of Aſtronomy.

From whence it may be obſerved, that if this Gentleman had conſidered this Appearance thoroughly, he

would

would have ſaved himſelf an inexpreſſible deal of Trouble; and the above brief Demonſtration is fully ſufficient to confute Mr. BRADLEY, I preſume, notwithſtanding his very tedious and laborious Obſervations and Searches into Nature. But had he been ſo accurate a Geometer as he was an Obſerver of y Heavenly Bodies, as is univerſally allowed he was, he might poſſibly have made ſome Diſcovery; but I cannot ſee he has a juſt Claim to any.

I am really ſurprized he could aquieſce in ſo looſe and undemonſtrative an Idea or Principle as that the Propagation of Light could ever be the Cauſe of ſo many and ſuch different Circumſtances as he found exiſted in the Heavens. He ſays, that all the Stars, without Diſtinction, appeared to move Southward, while they paſſed in the Day, and Northward in the Night; for which Phœnomenon he does not pretend to give any geometrical, nor any other good, Reaſon. And this Gentleman alſo confeſſes, that the Stars being fartheſt North, or South, when the Sun was about the Equinoxes, was only true of thoſe near the Solſticial Colure. He alſo acknowledges that the Obſervations of ſome Stars would not correſpond with his Hypotheſis. Now, ſince no good Reaſons, I think, have yet been given for ſuch a Variety or Contrariety of Motions in the innumerable Fixed Stars, I would humbly ask this Queſtion, viz.

Whether every Fixed Star might not have an Orbit to travel? And, if ſo, perhaps there may not be two

Orbits alike either in Time, Direction, or Circumference. This Queſtion, I ſuppoſe, will make the inconſiderate Reader laugh and ridicule me for ſuch a wild or new Advance: But I have ſome Reaſon to believe a good Geometrician will have but little Cauſe for a Sneer, after ſtrict Enquiry. I know he will immediately object, and ſay, that if it was thus, the Fixed Stars would not keep their exact Stations or Diſtances from one another, as they are obſerved to do: But this Objection will quickly vaniſh, when he conſiders the vaſt Diſtance of the Stars from us; for if a Line of fifty Millions of Miles (which let us ſuppoſe to be the Diameter of a Star's Orbit) be ſeen five Hundred Thouſand Millions off, it would not appear under any conſiderable Angle. It is not, like a ſingle Star in the Heavens, to be beheld parallel-wiſe fifty Millions of Miles diſtant in Stations; it is a very different Caſe, as I have largely explained already.

POSTCRIPT.

In Fig. 3. Pl. 5. the whole Axis of the Earth's Orbit I H, ſhould have been drawn falling backwards towards D, as well as pointing to another Star, &c. Weſtwards: But, after all my Searches concerning the Cauſe of this abſtruſe Phœnomenon, &c. I muſt acknowledge that I do not aſſert that this Chapter is either a Phyſical or Mathematical Demonſtration of it, ſtrictly; tho' I own that I at firſt intended it; wherefore I ſhall at preſent ceaſe my Enquiry, and be content, juſtly allowing the GREAT CREATOR's Skill to be infinite, and his Ways paſt finding out. But if all our Solar Syſtem, or even our Earth's Orbit, ſhould move towards the ~~South~~ West, (and I know not any Improbability in it) then this Motion would, in the moſt ſimple Manner poſſible, fully account for this Difficulty, which has ſo much puzzled the LEARNED. But let us not enquire about thoſe Things which don't much concern us.

" Thro' Worlds unnumber'd, tho' the GOD
be known,
" 'Tis ours to trace him only in our own.

FINIS.

N. B. a further acc. will be publish'd con
rning this difficult Matter & given Gratis

Having but little Acquaintance with the World, and this Treatiſe being of an uncommon Nature, I have ſcarce ſollicited any Subſcriptions abroad, conſequently cannot expect the Number to be great: But as ſome Gentlemen of the Neighbourhood have been pleaſed to encourage the Work, I have here preſumed to inſert their Names.

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N. B. Spheric Trigonometry, even on the preſent Hypotheſis, will not truly point out the Difference of the Increaſe and Decreaſe of Days, as our Aſtronomers imagine and practiſe, even if the Sun was ſeated in the Center of the Earth's Orbit: For the true Meaſure is not on the Arch of a Circle, but on a Right Line; and is the ſhorteſt Diſtance poſſible from the Plane of the Equinoctial to the Earth in her Orbit. Hence our greateſt Aſtronomers have hitherto proceeded Unmathematically.

Plate 1

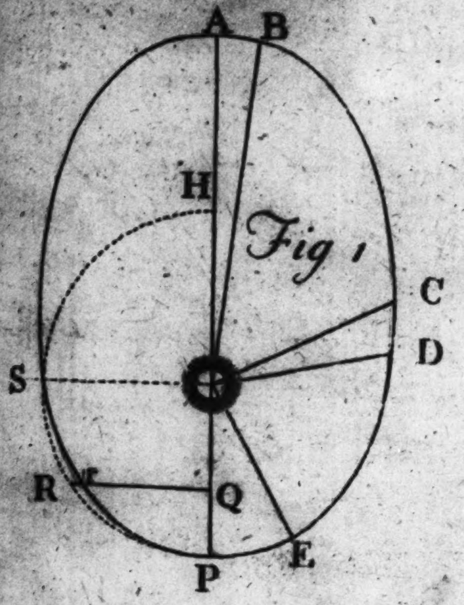


Fig 1

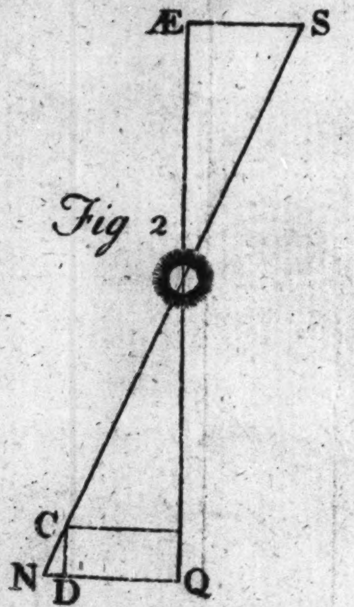
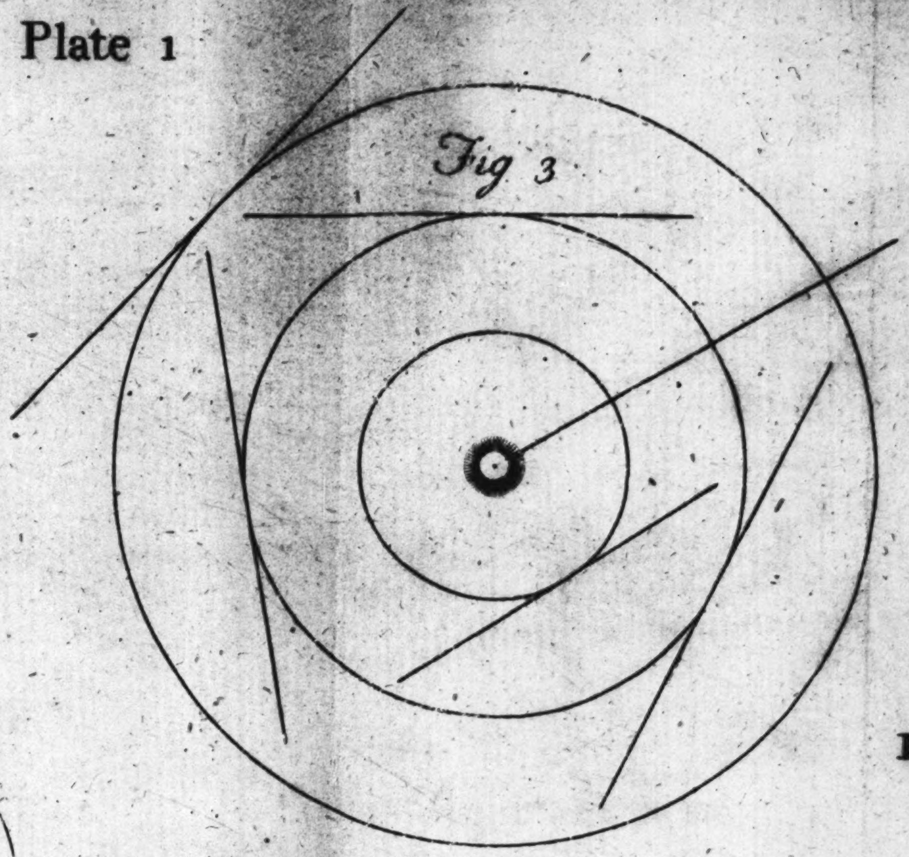


Fig 2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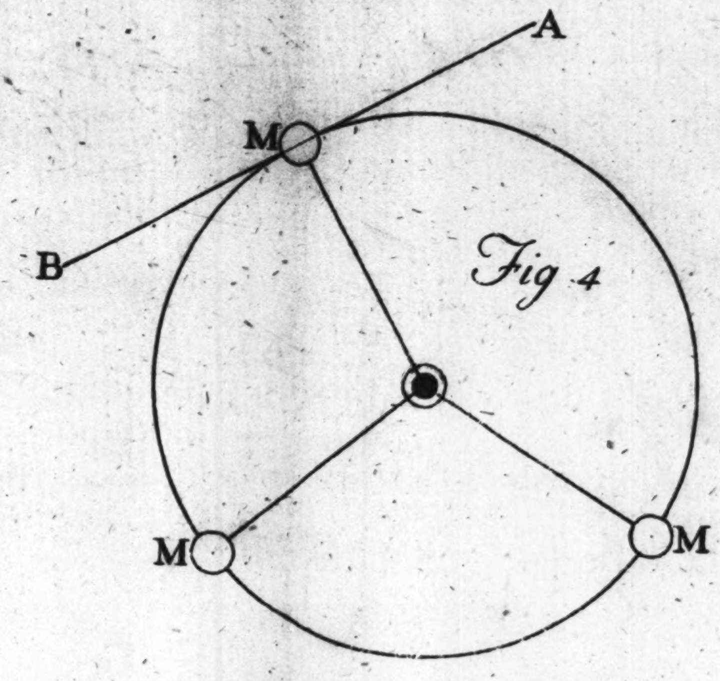
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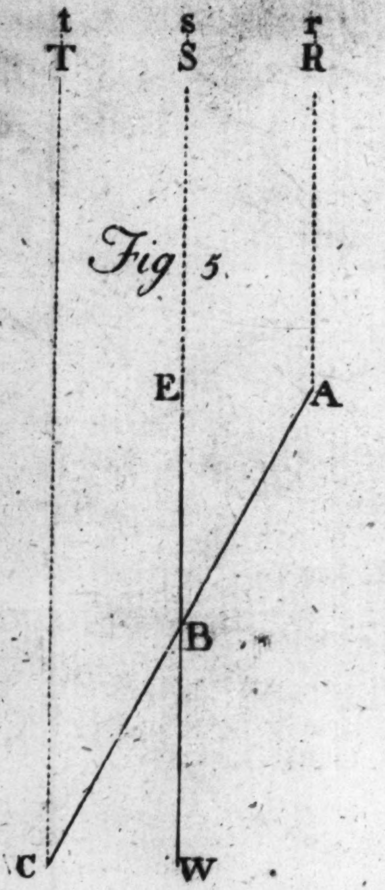
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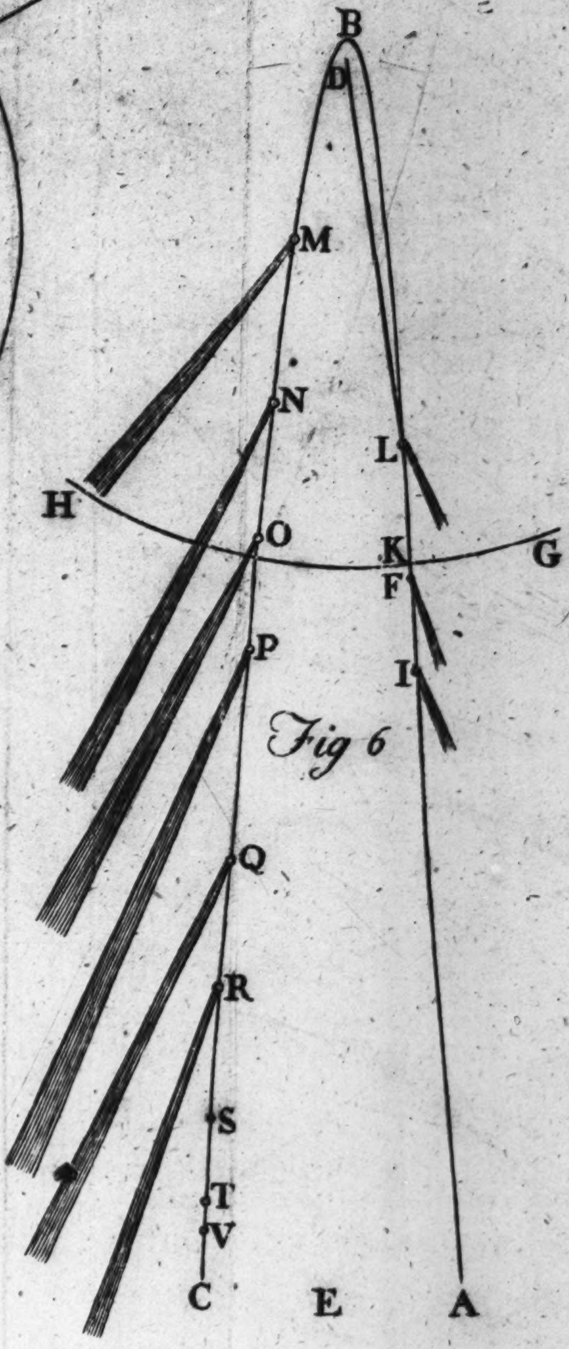
Fig 6

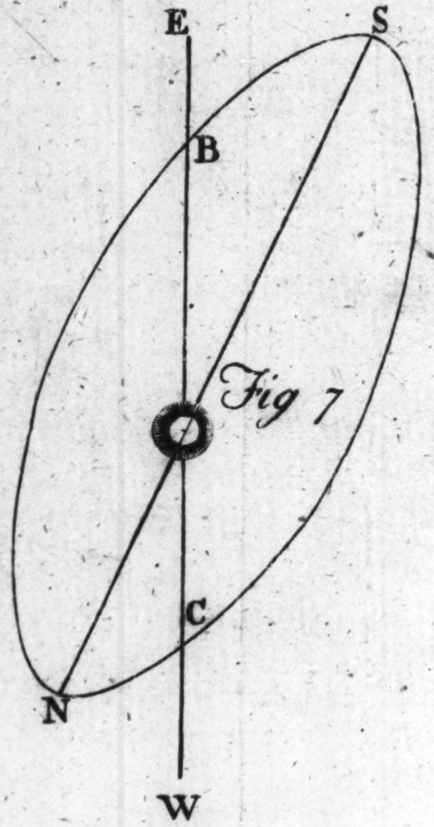
Fig 7

Plate 2

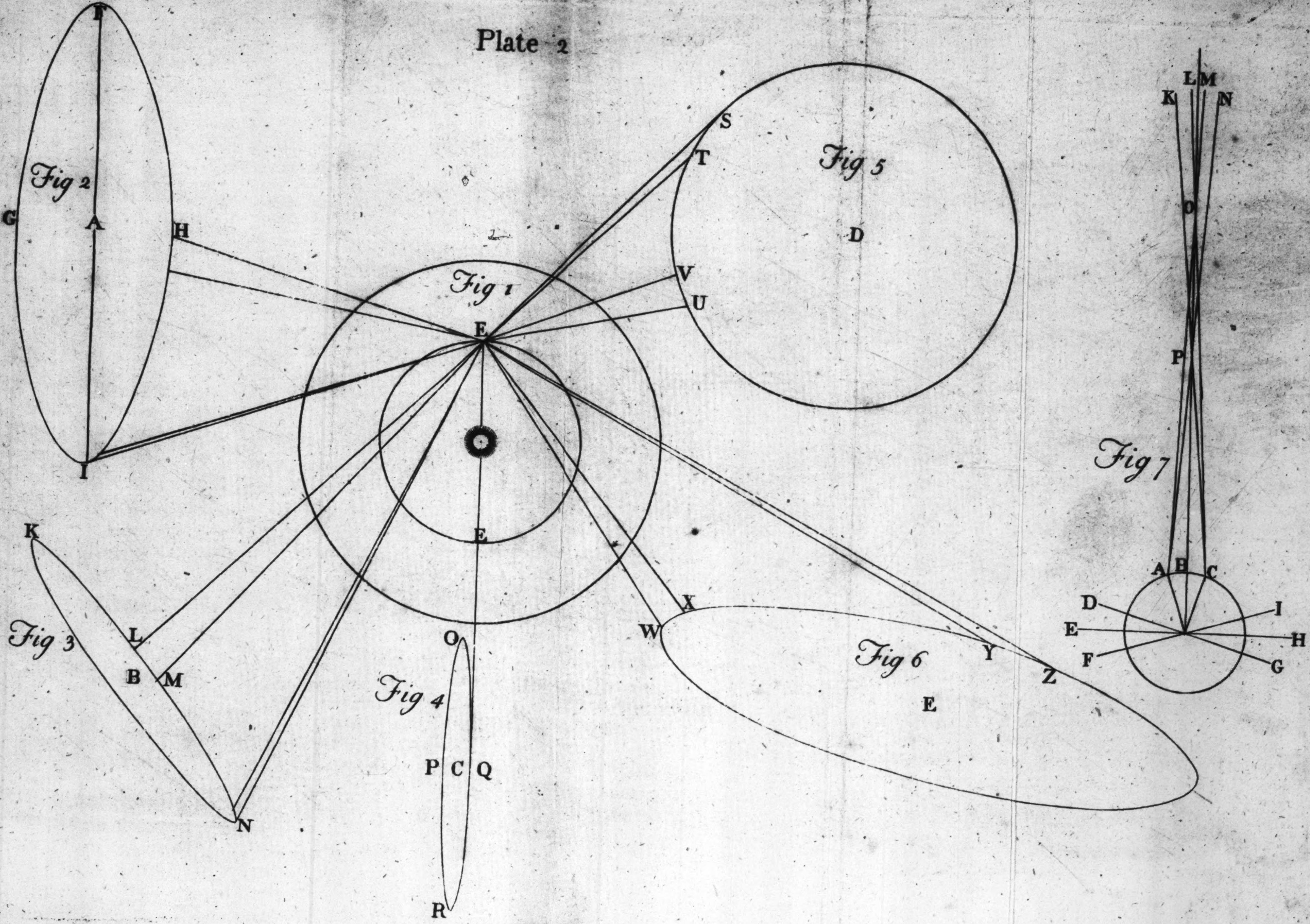
Fig 2
F
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Fig 1
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Fig 5
S
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Fig 3
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Fig 6
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Fig 7
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G

Plate 3

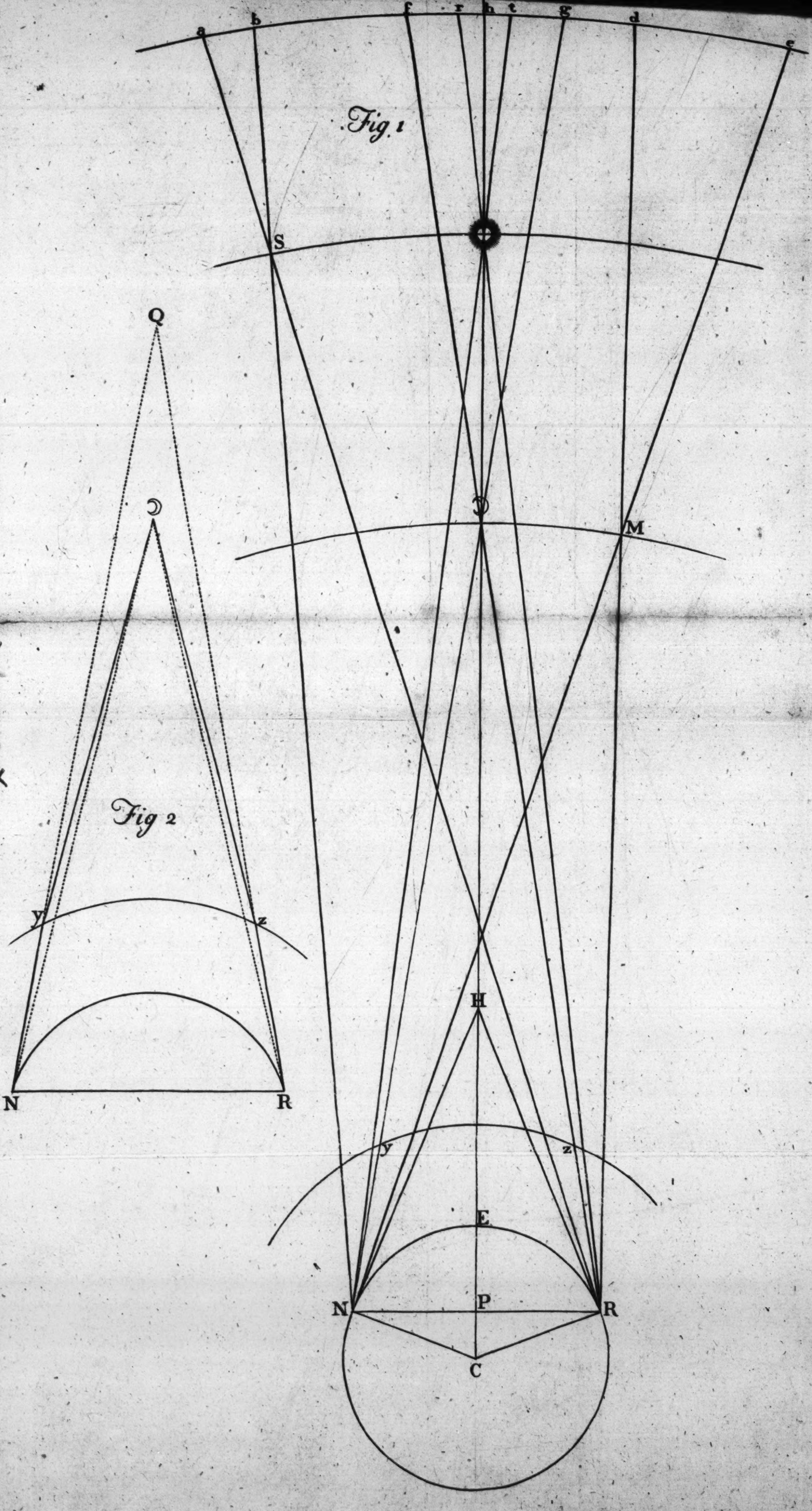
Fig. 1

Fig 2

Plate 4

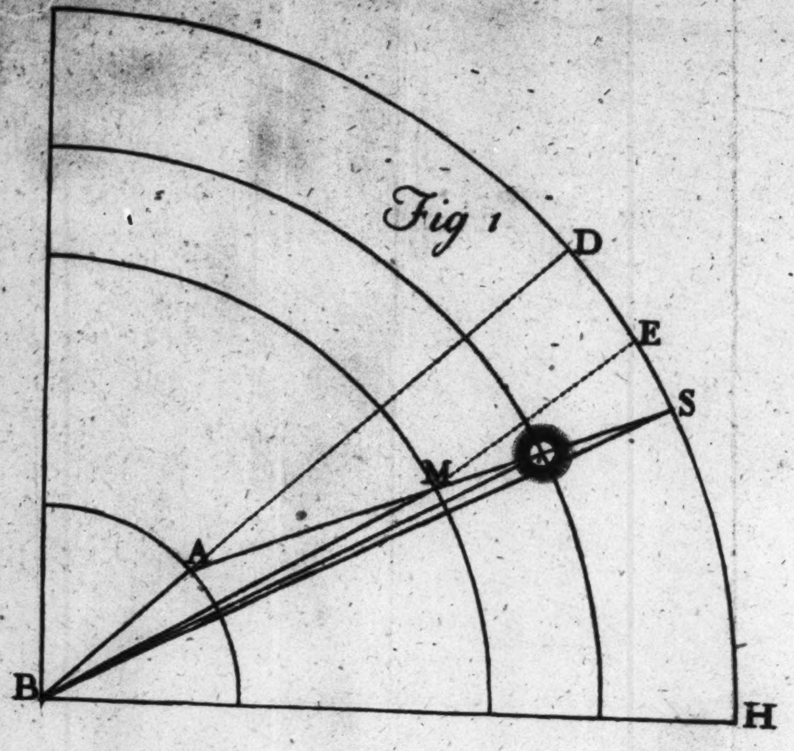
Fig 1

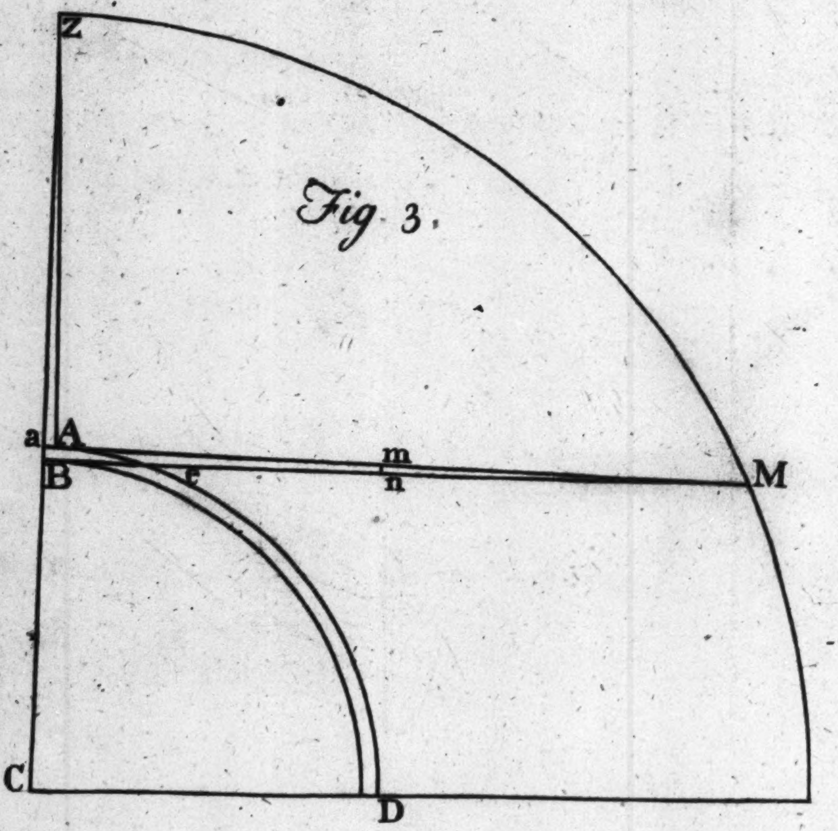
Fig 3

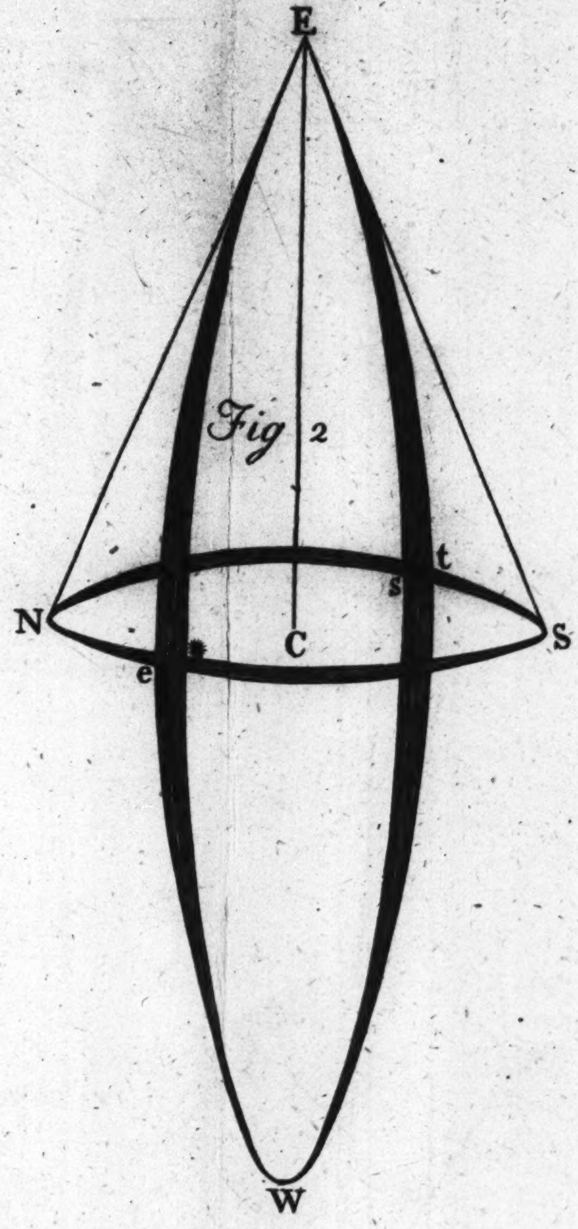
Fig 2

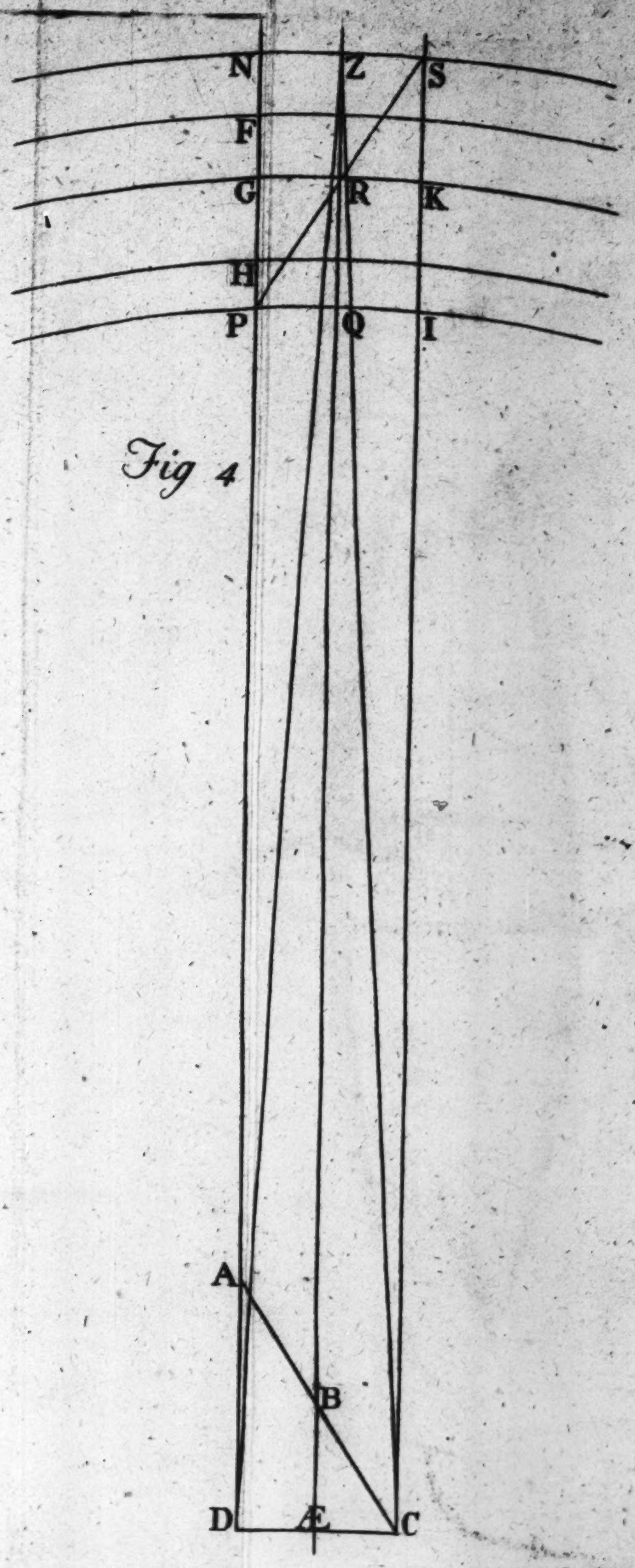
Fig 4

Plate 5

Fig 1

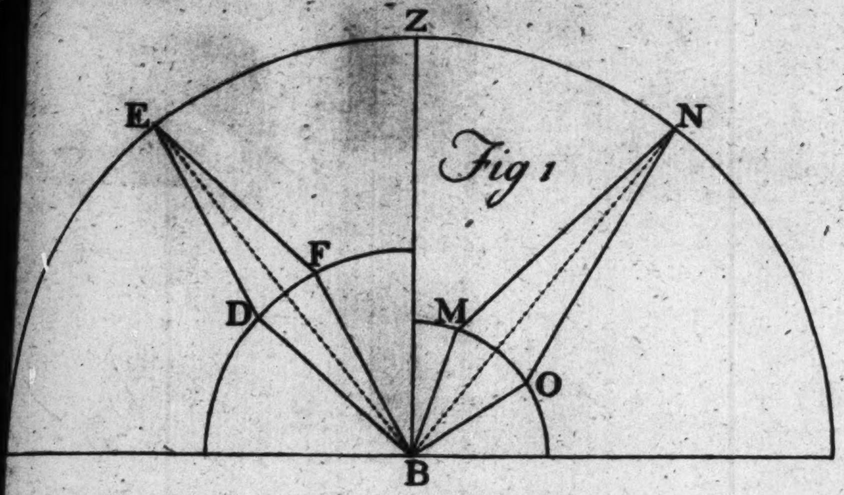

Fig 2

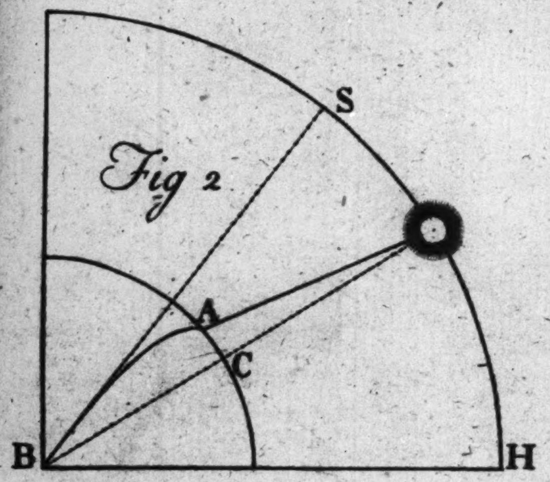

Fig 3

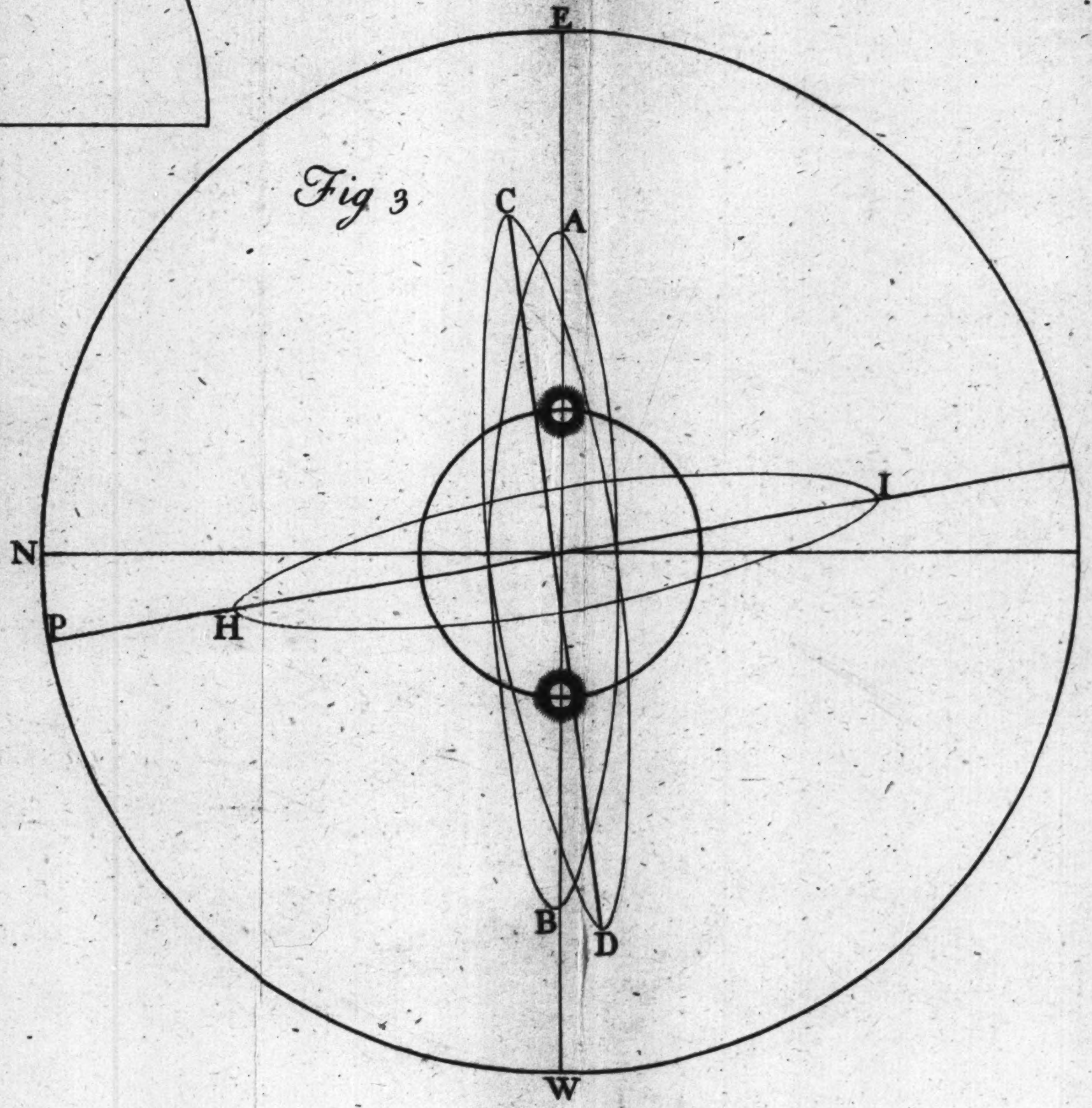

Fig 4